

TECHNICAL REPORT NO. LWL-CR-05S70

LIGHTWEIGHT FLOTATION GEAR FOR INDIVIDUAL SOLDIERS  
WITH  
SEMI-AUTOMATIC INFLATION DEVICE

Final Report

Contract No. DAAD05-71-C-0444

January 1972

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COUNTED IN

In Collaboration with

Norman P. Leibel  
U. S. Army Land Warfare Laboratory

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U. S. ARMY LAND WARFARE LABORATORY  
Aberdeen Proving Ground, Maryland 21005

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AD-741345

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## ABSTRACT

The purpose of this task was the finalization of the design of a lightweight, reuseable, flotation device for the individual soldier.

This task had two basic objectives. The first was to make a comparative evaluation of the automatic inflation valves which are available from three different manufacturers.

The second objective was to fabricate fifty preproduction prototypes of the inflation gear. Fabrication of these prototypes facilitated finalizing the design of the component parts which were then detailed on fabrication and assembly drawings.

The complete flotation gear weighs approximately two pounds. It consists of three separate flotation cells mounted on an adjustable belt. The device is inflated either manually or automatically by releasing carbon dioxide gas from a small pressurized cylinder. If required, the device can also be breath inflated.

This report provides a comprehensive description of the inflation gear, along with some discussion of the alternate designs that had been considered and the decisions that led to the selection of the final components.

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## 1. INTRODUCTION

Troop movement is often impeded by the need to cross streams or rivers. It would be ideal for the commander to be able to move his troops across a river without the need for extraneous equipment or without the risk of losing personnel due to drowning while fording a stream or river.

The military experience in Vietnam established the need for a flotation device for the individual soldier. This development was undertaken to provide such a device - a device which would safely float an individual, with complete field gear, across a waterway.

In order to be of real value to the field commander, it was determined that the unit should be lightweight and compact. It should not encumber the soldier in his normal mission. It should encompass a means for manual "erection" for any anticipated water crossings. It should provide automatic buoyancy if an individual inadvertently falls into deep water or is swept away while fording a stream. It should have both an automatic and a manual mode of operation. The manual mode would reduce the individual's fear of fording fast streams. In case of emergency, he could activate the flotation gear.

The development of such a device was undertaken by the U. S. Army Land Warfare Laboratory.

The U. S. Army Land Warfare Laboratory wishes to acknowledge in particular the effort of the Franklin Institute Research Laboratories of Philadelphia, Pennsylvania. In addition, we wish to acknowledge the cooperation of the following Agencies and Laboratories for their assistance in the completion of this project.

1. Chellife Corporation  
Felton, Delaware

2. I.L.C. Industries, Inc.  
Dover, Delaware
3. Bainbridge Naval Training Center  
Bainbridge, Maryland
4. U. S. Naval Air Development Center  
Johnsville, Pennsylvania



## 2. CONCLUSIONS

The inflation valve manufactured by Chellife Corporation of Felton, Delaware, was determined to be equal to the valve manufactured by ILC Industries of Dover, Delaware, and required no modifications for use with the flotation gear.

No suitable quick release device is commercially available. A quick release buckle based on the present rucksack configuration, but also including an adjustable size feature, was designed and incorporated into the fifty pieces of gear.

The flotation gear can be manufactured in quantity using the detail and assembly drawings that were prepared as a part of this project.

### 3. DESIGN CRITERIA

#### 3.1 Background

As a result of a letter from USACDCSWCAG to USACDCSW dated 1 April 1966, USALWL initiated a task (07-S-67) in May 1966 to develop a breath inflated flotation device which could support a man carrying 60 pounds of field gear. This flotation device was developed for planned river crossings. Two hundred of these gear were shipped to RVN in February 1968. The device weighed eight ounces and was designed to be repackaged for reuse as required. This flotation gear was evaluated by the 9th Infantry Division and the results were favorable. It was recommended that the gear be procured and issued on the basis of one per individual operating over water or in inundated areas.

As a further result of the 9th Infantry evaluation and USALWL's LNO reports, a new task was initiated (05-S-70) in July 1969 to develop a flotation gear having an automatic valve which would inflate after being submerged in two feet of water. USALWL's comprehensive program of research and investigation, along with the evaluation of tests that had been coordinated with selected military units, enabled military personnel to prepare a list of operational characteristics around which a flotation device could be developed.

Early in 1971 under the direction of LWL, The Franklin Institute Research Laboratories (FIRL) developed and had fabricated four prototype flotation devices. Evaluation of these units confirmed that they were dependable and rugged, that they provide adequate buoyancy, orientation and maneuverability and were well adapted to use in conjunction with other field gear including the rucksack frame combat pack and parachute harness.

The previous work assignment had also established the need for certain specific improvements. For example, during one of the parachute jump tests, the inflation valve twisted on the manifold "D" stud causing

a malfunction which prevented the gear from inflating properly. Examination of the affected parts showed that the clearance dimensions were too large. The mating dimensions and tolerances for both the "D" stud and the valve body need to be clearly specified.

Repeated connection and removal of the gas cartridges from the inflator indicated that the plastic body valves did not provide sufficient resistance to cross threading. In order to improve this, and the wear characteristics in general, a helicoil insert will be required.

The metal CO<sub>2</sub> canister was found to cause freeze burns and reflected light due to the bright metal finish. A simple nylon cover was devised to be slipped over the canister to eliminate this problem.

Some pouches began to tear at the belt loop; a redesign was suggested to provide two plies of nylon fabric around the belt and larger radii in the inside corners of the pouch and bag pattern.

The standard garrison buckle did not allow quick release of the gear and the method of adjustment for variable sizes left a loose end without any means of confining it around the individual's waistline. It was suggested that the automotive seat belt buckle be considered as one possible design offering the quick disconnect feature.

### 3.2 Buoyancy

Buoyancy requirement, including configuration control to provide proper attitude and freeboard, were determined by the U. S. Army Land Warfare Laboratory in an earlier project. The results of the buoyancy experimentation are presented in the U.S. Army Land Warfare Laboratory Technical Report No. 68-07.

Figure 3.2.1 shows the original concept of a production model for a breath inflated unit. In the inflated condition, the flotation bags form a "U" around the individual. One flotation bag is positioned under each arm and one bag is positioned across the chest. The underarm bags provide adequate freeboard and will support an individual in an unconscious state.

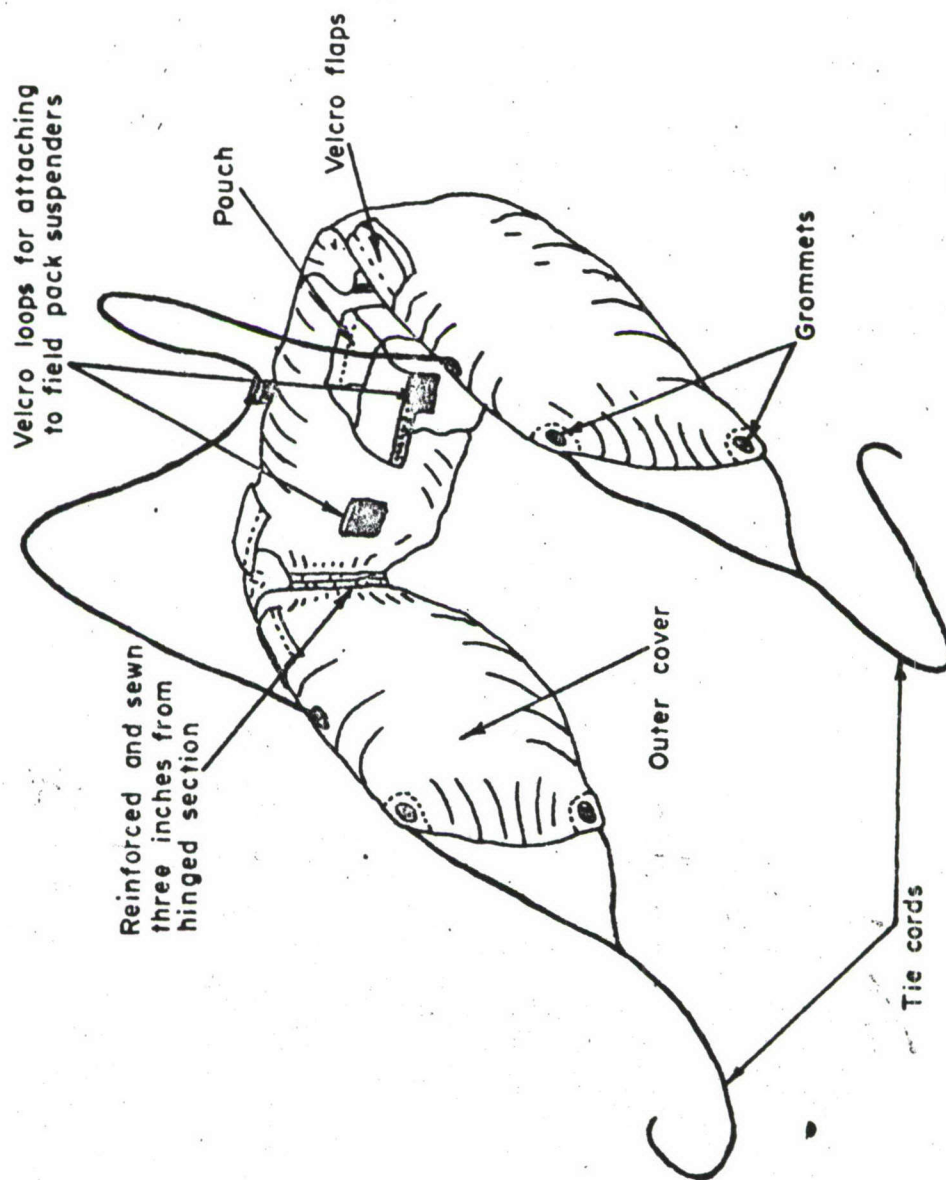


Figure 3.2.1. Breath Inflated Flotation Gear



The underarm bags extend toward the rear and provide buoyancy for a 60 lb. field pack. The rear extension of the underarm bags, along with the front bag, supports the individual in a vertical attitude. The individual is supported with shoulders and head above water. The front bag provides head support in case the individual is unconscious. The individual's weapon can be rested on the front bag, across the front end of the underarm bags in order to keep the weapon above the water and allow the arms free for holding a guideline or paddling in the water.

The buoyancy requirements established in the U.S. Army Land Warfare Laboratory Technical Report No. 68-07 called for three separate flotation compartments. Each underarm flotation bag was 24 inches long and displaced .43 cu. ft. The front bag was 18 inches long and displaced .25 cu. ft. Total displacement was 1.11 cu. ft.

### 3.3 Gas Source

Several types of gas were reviewed as candidate gases for automatic inflation of flotation bags. Candidate gases included low pressure fluorocarbon gases, a selection of aliphatic hydrocarbons and chemical gas generator systems. The feasibility of low temperature, pyrotechnic gas generators was also considered.

Table I in Figure 3.3.1 lists the various types of gas considered. The table provides the weight, volume and cylinder pressure required to generate 1.1 cubic foot of gas at 70°F and 14.7 psi.

Freon 12 was initially selected as a desirable gas source. It can be stored in a low pressure container. It is non-flammable. Its lower pressure allows less expensive containerization and allows greater design variations in terms of inflator mechanisms.

Six Freon 12 units were furnished to the U. S. Army Land Warfare Laboratory under Contract No. DAAD05-68-C-0283. The units were tested by personnel of both the Franklin Institute Research Laboratories and the U. S. Army Land Warfare Laboratories.

Early experimentation with Freon 12 as a gas source indicated some freeze-up problems. Rapid evaporation and expansion of the freon caused the remaining liquid freon to freeze. Complete expansion and the rate of expansion is a function of the availability of heat and the rate of heat transfer to the freon.

The freeze-up problem of the freon can be overcome by providing a larger heat sink in the area of gas expansion, by reducing the rate of expansion, or by providing for expansion of the gas over a larger area. A larger heat sink requires more mass and greater complexity. Reducing the expansion rate was not acceptable within the intent of contract.

International Latex Corporation of Denver, Delaware, demonstrated a practical means of increasing the expansion area. Essentially, the arrangement consisted of incorporating an open web material, referred to as a wick, within the vicinity of expansion. Liquid freon was distributed over the open web material, thereby providing for expansion over a relatively large area. The International Latex Corporation claimed patent rights on this arrangement.

Three complete automatic flotation gear operating with freon 12 as the gas source were delivered to the U. S. Army Land Warfare Laboratory for initial review and evaluation. The units performed satisfactorily and the field test indicated that under normal conditions, freon was as acceptable gas source.

Evaluation of the units from the standpoint of operational reliability and operational speed at low temperatures indicated that freon was less desirable than CO<sub>2</sub>. Even though the "wick" system did a good job of allowing rapid expansion of the freon, the additional material increased both the weight and bulk of the inflation gear.

CANDIDATE COMPRESSED GASES OR GAS GENERATING SYSTEMS	WEIGHT		VOLUME		CYLINDER PRESSURE 70°F/1 Atmos. PSIG	REMARKS
	to Generate 1.1 Cubic Foot	Grams	to Generate 1.1 Cubic Foot	C.C.		
Carbon Dioxide	57		71		838	Heavy walled cylinder
Butane	77		128		18	Flammable
Ethane	39		29		543	Heavy walled cylinder
Isobutane	75		121		33	Flammable
Freon 12	158		122		70	Non-flammable
Freon 21	142		101		8	Non-flammable
Freon 22	114		95		12	Non-flammable
Freon 142B	139		93		30	Non-flammable
Freon 152A	94		63		63	Non-flammable
Methyl Chloride	65		29		59	Flammable
Vinyl Chloride	80		87		34	Flammable, Toxic
Phosphate Baking Powder*	209		105		--	NAHCO <sub>3</sub> + CaPO <sub>4</sub>
Tartrate Baking Powder*	354		177		--	NAHCO <sub>3</sub> + NAKC <sub>4</sub> H <sub>4</sub> O <sub>6</sub>
Acetylene - Cylinder Gas	34		57		250	Flammable, Stability Hazard
Acetylene - Carbide Reaction	84		42		--	Flammable
Calcium Hydride Decomposition	127		75		--	CaH <sub>2</sub> + 2H <sub>2</sub> O → Ca(OH) <sub>2</sub> + H <sub>2</sub>
Sodium Azocarbonylate	335		168		--	N <sub>2</sub> generated with H <sub>2</sub> O

\* Oxalic, Tartaric and Sulfuric Acid Baking Sodas were also considered, but they presented no advantages.

Table 1.

FIGURE 3.3.1



As directed by the U. S. Army Land Warfare Laboratory, the Franklin Institute continued the development of the flotation gear, utilizing CO<sub>2</sub> as a gas source in lieu of the freon compounds. Automatic flotation gear, utilizing CO<sub>2</sub> as a gas source, were delivered to the USALWL and tested. The CO<sub>2</sub> units were reliable, fast and the operation of the units with CO<sub>2</sub> proved superior to the freon units.

CO<sub>2</sub> in 2 oz. cans (56.7 grams) was determined as the preferred gas source. It is available in the Federal Stock System, FSN4220-837-3322.

### 3.4 Inflator

The term "inflator" is used herein to refer to any mechanism which can be used to release the gas from its container and introduce the gas into the manifold system for distribution to the inflation bags.

Numerous devices of this type are commercially available. They are used on all types of flotation devices from small individual to large, multi-passenger life rafts. They are often custom designed to fulfill the requirements of a specific market. An example of such a device is the unit manufactured by Lifeguard Manufacturing Corporation under U. S. Patent No. 3,242,514 (Figure 3.4.1).

In accordance with the original intent of the program, various arrangements for automatic valving of a low pressure gas were reviewed. Figures 3.4.2, 3.4.3 and 3.4.4 show some of the valve arrangements considered. The arrangement shown in Figure 3.4.4 indicated the greatest probability of meeting the original intent of providing a reliable, compact and simplified inflator.

A model, generally in accordance with Figure 3.4.3, was fabricated and tested in the laboratory. The inflator unit functioned satisfactorily although some problems did occur due to rapid expansion of the freon 12. Problems resulted from freeze-up in the freon can, in the neck of the can, and in the manifold and tubing system leading to the bags. Some effort was expended to overcome these problems and a limited degree of success was obtained. However, additional development effort would have been



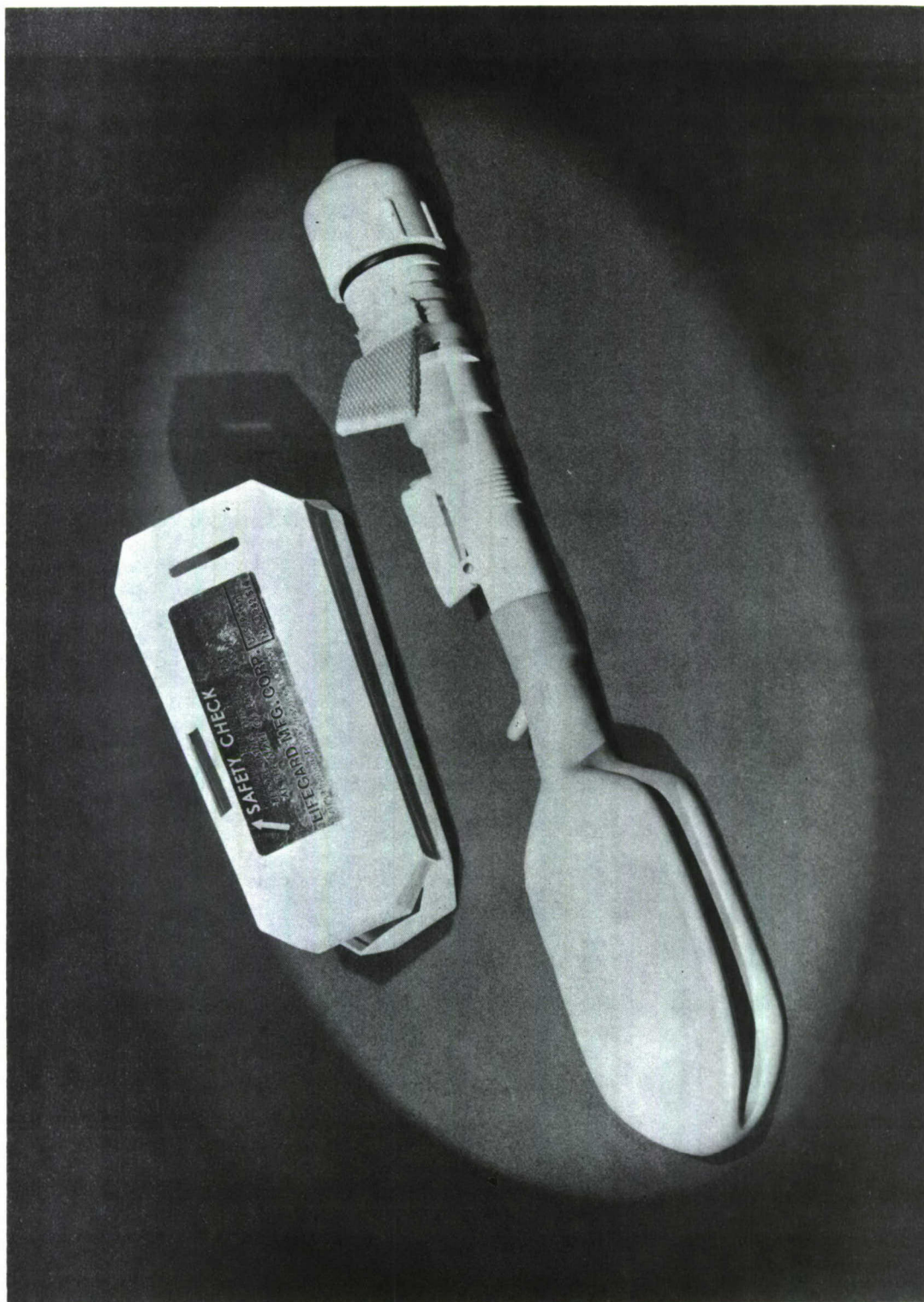
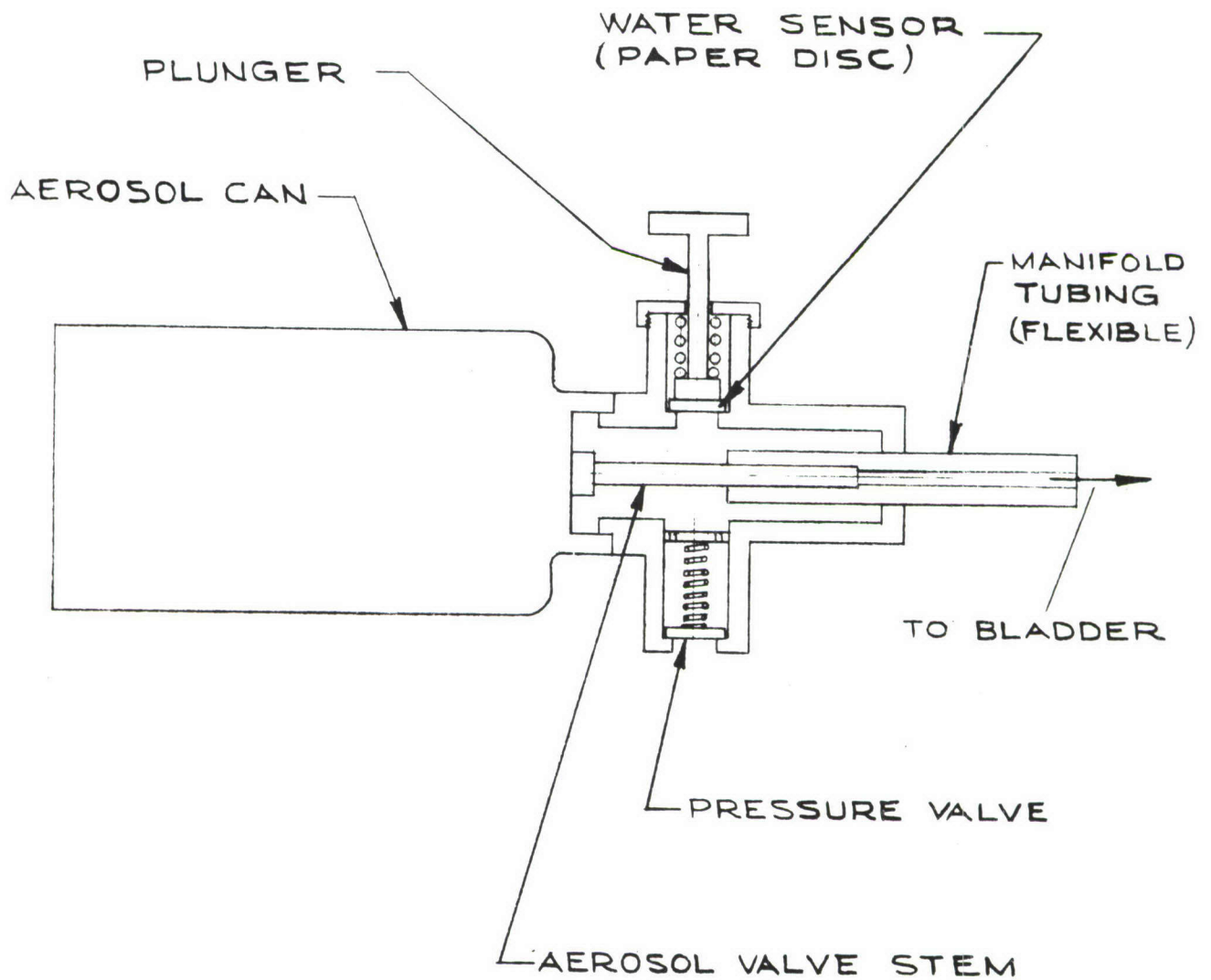


Figure 3.4.1. Lifeguard Mfg. Co. Flotation Device



GAS RELEASED BY RADIAL FORCE OF  
PLUNGER AGAINST AEROSOL VALVE SYSTEM

Figure 3.4.2. Inflator Concept

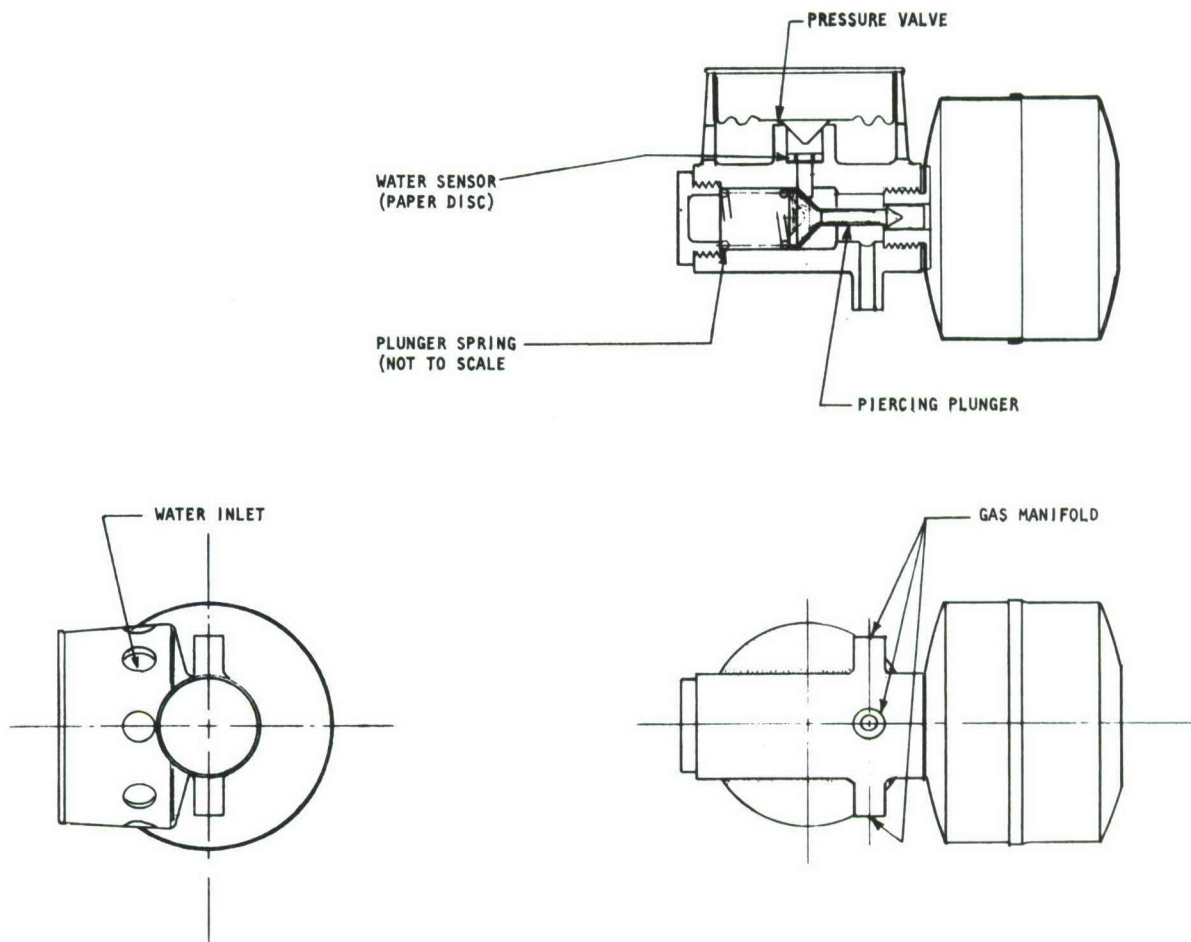


Figure 3.4.3. Inflator Concept

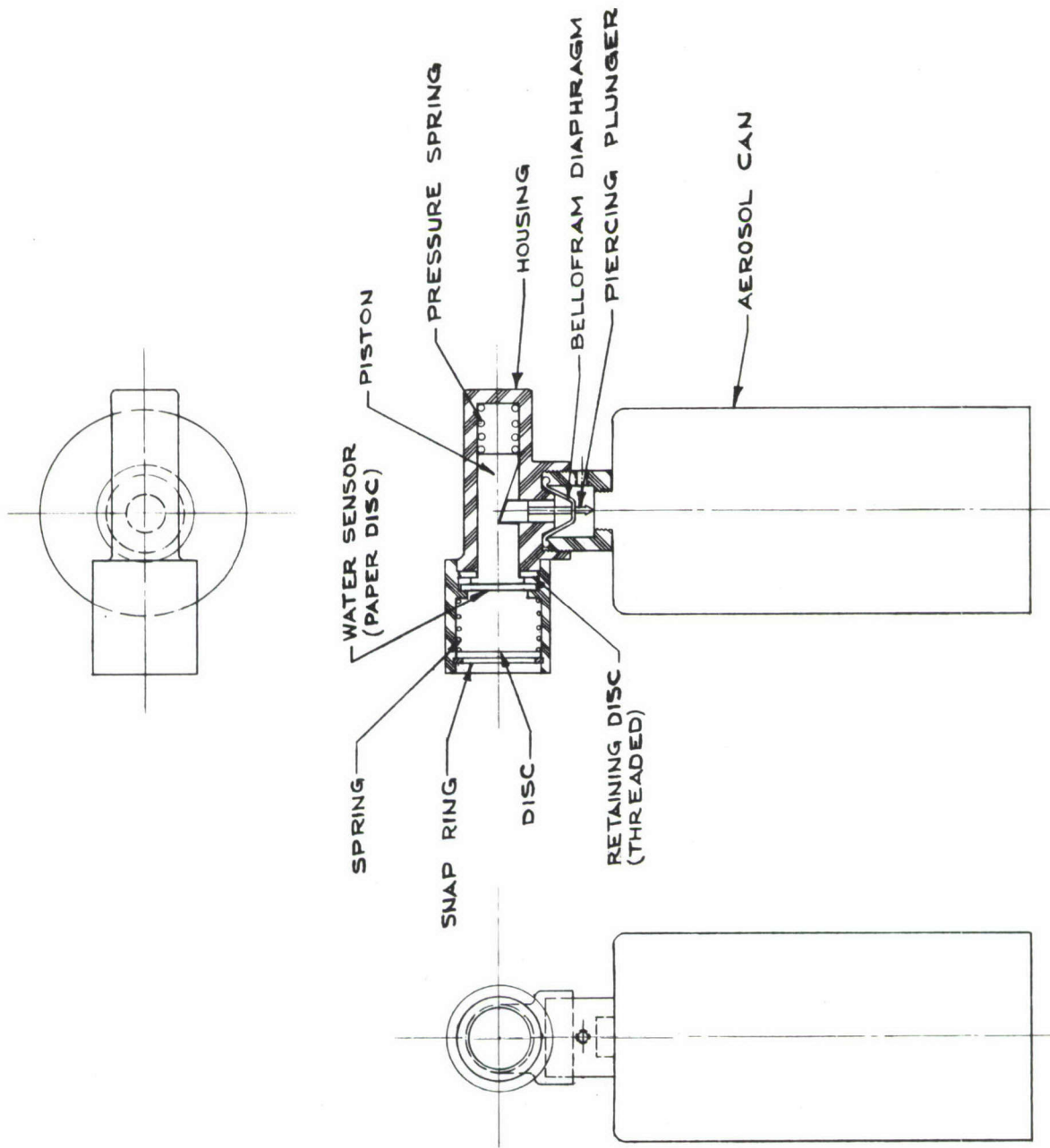


Figure 3.4.4. Inflator Concept

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required to develop a satisfactory unit.

In accordance with the original intent of the program, commercially available units were evaluated in anticipation of obtaining a satisfactory inflator. A device available from International Latex Corporation in Dover, Delaware, was selected as the best candidate design to fulfill the overall technical need for a low pressure, automatic valve. It was designed to fit a standard military "D" stud. It has both a pressure sensing element and a water sensing element for automatic sensing of water immersion. It has a lanyard for manual operation in case of failure of the automatic mode.

Six units were purchased for test and evaluation. Figure 3.4.5 shows the valve and describes operating instructions.

The units performed very well; however, evaluation by Military Personnel indicated the desirability of incorporating certain modifications. The modifications included:

- ° Provide a subverter cap in order to subvert automatic operation in certain tactical situations.
- ° Replace the lanyard with a large "D" ring or knob in order to allow the individual to distinguish, by feel, the manual actuator from a loose strip of his field gear harness.
- ° Modify the manual actuation such that manual operation did not destroy the water sensing disk.

In accordance with the above request, modifications were incorporated into the inflator. These modifications included:

- ° Adaption for use of CO<sub>2</sub>
- ° Separation of piercing pin from spring and piston used for automatic operation, such that piercing pin can be manually operated without disturbing automatic feature
- ° Providing a subverter cap to close off the water ports leading to water sensing element
- ° Providing a large pull knob in lieu of the lanyard.

Four units were fabricated by the International Latex Corporation in accordance with the requested modifications. The units were tested and performed satisfactorily. The design arrangement was evaluated and accepted by USALWL. Figure 3.4.6 shows this valve and describes the operating instructions.

During evaluation, the CO<sub>2</sub> proved to be a more reliable and faster gas source. The ability to manually operate the unit without disturbing the automatic feature was accepted. This added feature will permit the use of the flotation gear as an operational piece of equipment as well as a life-saving piece of equipment.

The subverter feature will enable an individual to swim underwater or ford a deep stream without having the automatic feature activate. The unit can be operated manually in case of emergency.

The large distinctive shape of the pull knob allows an individual to easily identify it by touch, and it can be easily operated by either the right or left hand.

Effort was expended to incorporate a visual inspection feature. This was necessary in order to determine if a unit was properly charged for automatic firing without complete disassembly of the unit. ICL was given an opportunity to adapt their units for visual inspection. They did not feel it was feasible, and therefore, another source of supply was investigated. The Chellife Corporation manufacturers a similar inflater unit and they felt that the incorporation of a visual indicator was feasible. Under the direction of USALWL, the Chellife Corporation incorporated a viewing window in the top of the paper disc enclosure and painted the top of the activating piston with red paint. By visual inspection through the viewing port, the condition of the paper disc or its absence could be readily determined. Observation of any portion of the red top of the activating piston indicated the need for recharging.

The condition of the water soluble pill in the Rubber Fabricators Inc. unit can be determined by viewing through the ports of the flooding chamber.

Consideration was given to recharging the automatic feature in inclement weather. No real improvements appeared possible without extensive redesign and development. This consideration was determined as



# RECHARGE INSTRUCTIONS FOR WAID II AUTOMATIC INFLATOR

1. Read all steps before attempting to disassemble or recharge the WAID II Inflator. Refer to Figures 1 and 2.
2. Remove INFLATION AGENT CONTAINER. See Figure 1.
3. Operate MANUAL ACTUATING LEVER and remove Broken SAFETY WIRE. See Figure 1.
4. Remove (unscrew) MANUAL ACTUATING ASSEMBLY by rotating the knurled nut which capivates the assembly. See Figure 1.
5. Remove the POWER SPRING and PIERCING PIN.
6. Remove (unscrew) the SENSING HEAD ASSEMBLY.

NOTE: Clean the SENSING HEAD ASSEMBLY immediately upon removal by the following step by step procedure:

- A. Depress the diaphragm seal of the SENSING HEAD ASSEMBLY using the POWER SPRING. See Figure 2.
- B. Immediately after depressing the diaphragm, press the lips tight against the open end of the SENSING HEAD ASSEMBLY and blow hard to clear all foreign matter from the valve seat. The diaphragm should slowly return to its seat after being depressed with the POWER SPRING -- If the return is rapid, the diaphragm or the SENSING HEAD ASSEMBLY should be repaired or replaced. If the motion is slow, the diaphragm is probably being held in the closed position by debris or when attempting to clear same. In other words, if extrinsic difficulty in clearing the valve is encountered, immediately after the diaphragm is depressed the SENSING HEAD ASSEMBLY should be presumed defective.
- C. Dry the SENSING HEAD ASSEMBLY paying special attention to the valve seat area. Be sure to wipe all foreign matter and moisture from the threads of the SENSING HEAD ASSEMBLY.

7. Remove COMPRESSION WASHER and residus of soluble disc. See Figure 1.
8. Remove the RESTRAINT PIN.

9. Clean and dry all remaining parts both inside and out.

10. When the parts are dry, reassemble the inflator as follows: See Figure 1.

- A. Install the PIERCING PIN.
- B. Install the POWER SPRING.
- C. Install the RESTRAINT PIN come end down such that it engages the tapered portion of the PIERCING PIN.
- D. Replace the SOLUBLE DISC.
- E. Install the COMPRESSION WASHER.
- F. Install the SENSING HEAD ASSEMBLY being careful not to dislodge the COMPRESSION WASHER.
- G. Lightly "hand" tighten the SENSING HEAD ASSEMBLY such that the slot in the outer shell of the SENSING HEAD ASSEMBLY will align with the MANUAL ACTUATING LEVER.
- H. Press the MANUAL ACTUATING LEVER ASSEMBLY on the POWER SPRING and depress the POWER SPRING until the ACTUATING LEVER ASSEMBLY knurled nut can be rotated to engage the threads of the inflator housing.
- I. Continue tightening the ACTUATING LEVER ASSEMBLY knurled nut, such that the ACTUATING LEVER positions itself within the slot on the SENSING HEAD ASSEMBLY shell and the knurled nut is snug.
- J. Install a new safety wire and the inflator is ready for reuse.

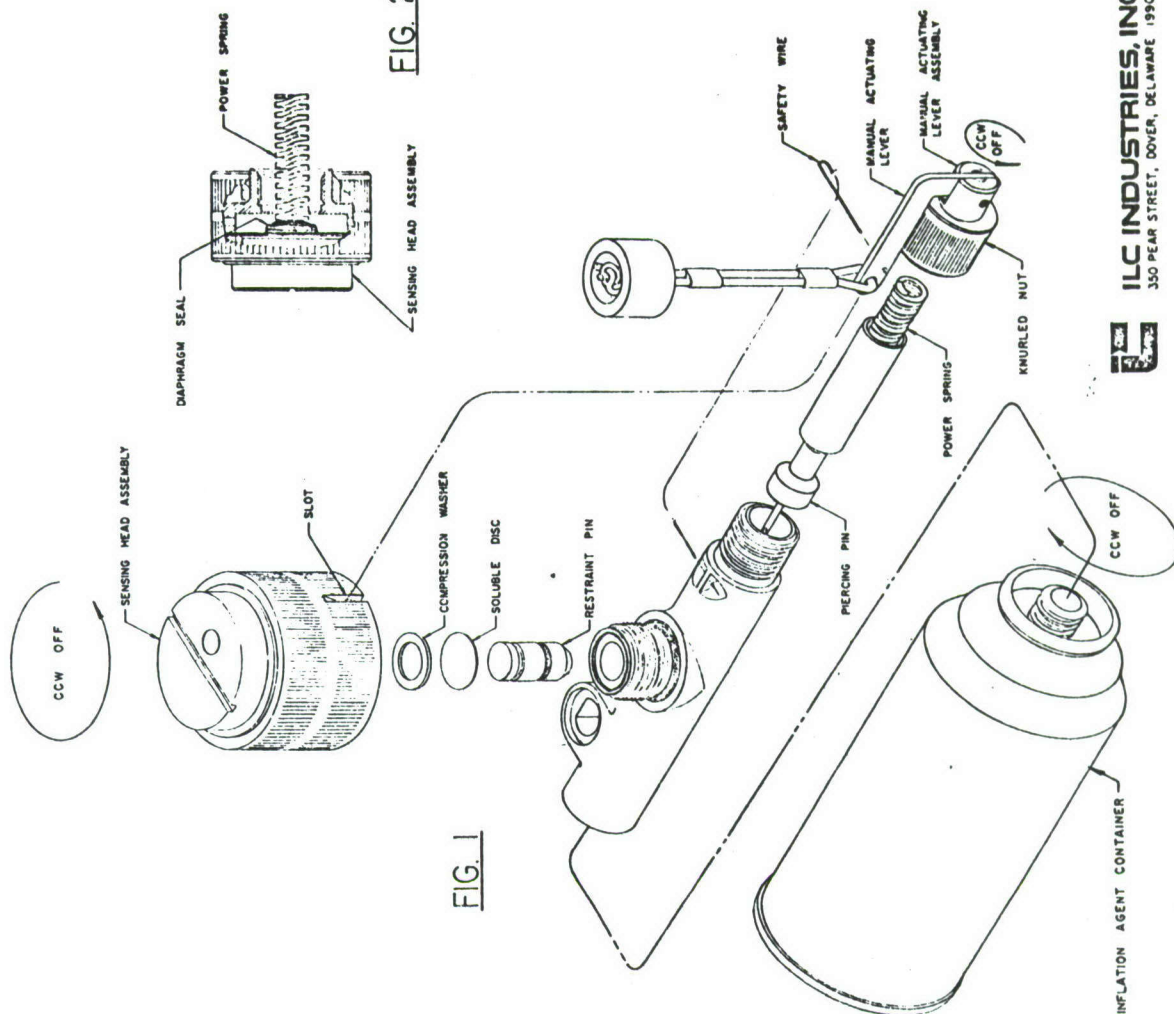


FIG. 2



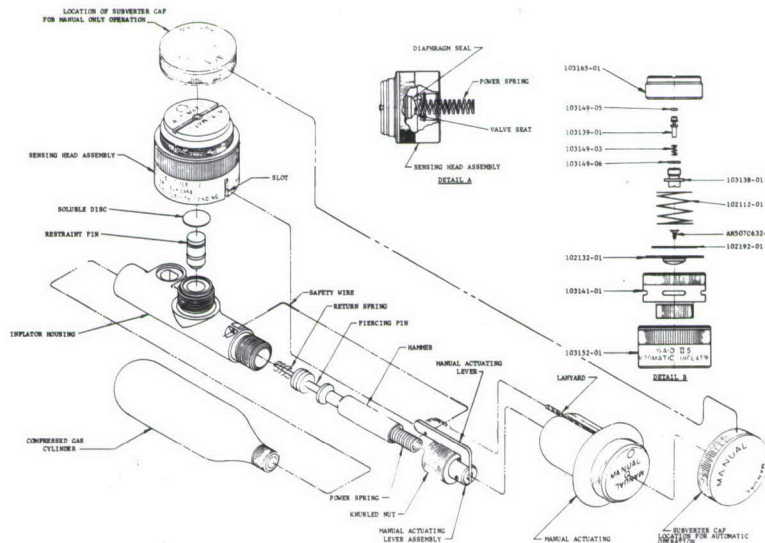
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Figure 3.4.5. I.L.C. Freon Inflator

# WAID II-S

## AUTOMATIC INFLATOR OPERATING INSTRUCTIONS

1. Read all steps before disassembling or recharging the WAID II-S Inflator. See Figure below.
2. Remove COMPRESSED GAS CYLINDER.
3. Operate MANUAL ACTUATING LEVER by pulling MANUAL ACTUATING KNOB and remove broken SAFETY WIRE.  
  
NOTE: If the inflator has been manually discharged and was not automatically operated, it will not be necessary to perform steps 4 through 11i.
4. Unscrew the KNURLED NUT, releasing the MANUAL ACTUATING LEVER ASSEMBLY.
5. Remove the POWER SPRING and HAMMER.
6. Unscrew and remove the SENSING HEAD ASSEMBLY. If the SUBVERTER CAP is in place on the SENSING HEAD ASSEMBLY, it should be cleaned, dried and stored on the MANUAL ACTUATING KNOB.
7. Clean the SENSING HEAD ASSEMBLY as follows:
  - a. Depress the DIAPHRAGM SEAL of the SENSING HEAD ASSEMBLY using POWER SPRING and hold the diaphragm in the depressed position (as shown in Detail A) for 10 seconds.



- b. Immediately after depressing the DIAPHRAGM SEAL, orally force air through the open end of the SENSING HEAD ASSEMBLY to clear all foreign matter from the DIAPHRAGM SEAL and VALVE SEAT. The DIAPHRAGM SEAL should return slowly to the VALVE SEAT after being depressed with the POWER SPRING -- if the return is rapid, the DIAPHRAGM or the SENSING HEAD ASSEMBLY should be repaired or replaced. If valving malfunction occurs it is readily detectable by the degree of difficulty encountered when attempting to clear same. In other words, if extreme difficulty in clearing the valve is encountered immediately after the diaphragm is depressed, the SENSING HEAD ASSEMBLY should be presumed defective and should be repaired or replaced. However, after the DIAPHRAGM SEAL has completely and properly reseated, it should be difficult to blow the DIAPHRAGM SEAL off the VALVE SEAT.
- c. Dry the SENSING HEAD ASSEMBLY paying special attention to the VALVE SEAT area. Be sure to wipe all foreign matter and moisture from the threads.

Normally the SENSING HEAD ASSEMBLY can be serviced without disassembly. However, if the SENSING HEAD ASSEMBLY is disassembled for any reason, all parts should be carefully cleaned, dried, and reassembled in accordance with DETAIL B. Fresh water may be used to rinse away mud and other foreign material.  
DO NOT USE SOLVENTS OTHER THAN WATER TO CLEAN PARTS.
8. Remove the RESTRAINT PIN.
9. Remove the PIERCING PIN - Do not detach RETURN SPRING from the PIERCING PIN.
10. Clean and dry all parts both inside and out, leaving all "O" Rings in place during this procedure.
11. When the parts are dry, reassemble the inflator as follows:
  - a. Install the PIERCING PIN with RETURN SPRING attached.
  - b. Install the HAMMER.
  - c. Install the POWER SPRING.
  - d. Install the RESTRAINT PIN cone end down such that it engages the tapered portion of the PIERCING PIN.
  - e. Install new (DRY) SOLUBLE DISC.
  - f. Install the SENSING HEAD ASSEMBLY being careful not to dislodge the SOLUBLE DISC.
  - g. Lightly "hand" tighten the SENSING HEAD ASSEMBLY such that the SLOT in the outer shell of the SENSING HEAD ASSEMBLY will align with the MANUAL ACTUATING LEVER.
  - h. Press the MANUAL ACTUATING LEVER ASSEMBLY onto the POWER SPRING and depress the POWER SPRING until the KNURLED NUT can be rotated to engage the threads of the INFLATOR HOUSING.
  - i. Continue tightening the KNURLED NUT, such that the MANUAL ACTUATING LEVER positions itself within the SLOT on the SENSING HEAD ASSEMBLY shell and the KNURLED NUT is snug.
  - j. Press the MANUAL ACTUATING KNOB over the MANUAL ACTUATING LEVER ASSEMBLY.
  - k. Install a new SAFETY WIRE and secure.
  - l. Install new COMPRESSED GAS CYLINDER.
  - m. Position and secure the SUBVERTER CAP for the mode of operation desired.
  - n. If the WAID II-S has been removed from its associated floatation gear, it should be remounted as prescribed in the instructions for floatation gear maintenance.



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Figure 3.4.6. I.L.C. CO<sub>2</sub> Inflator



a minor restraint and the existing recharging technique was accepted as adequate.

All initial testing and evaluation was accomplished with ILC units, such as shown in Figures 3.4.7 and 3.4.8. ILC incorporated certain modifications, as requested, and their units were acceptable as modified. They indicated, however, that they could not incorporate continued modifications such as the viewing window without considerable investment. Their representative indicated that they could not justify absorbing additional development costs without obtaining a substantial order to cover tooling and set up charges.

Two automatic inflators manufactured by Rubber Fabricators, Inc. (Figures 3.4.9 and 3.4.10) and two automatic inflators manufactured by Chellife, Inc. (Middleton Industries) (Figure 3.4.11 and 3.4.12) were purchased and evaluated in accordance with Contract No. DAAD05-71-C-0444.

The RFI unit is triggered by the dissolving of a water soluble pill. The amount of water and the flooding required to dissolve the pill makes it difficult to incorporate a pressure port or valve. The weight of each inflator is listed below:

<u>Manufacturer</u>	<u>Weight (oz.)</u>
ILC	6.3
Chellife	4.5
RFI	5.6

The Chellife unit is essentially the same as the ILC unit except for the arrangement of the pressure sensing device and the mounting of the paper disc. Under the request of USALWL, the Chellife Corporation incorporated the viewing window and painted the top of the activating piston with a red paint. The Chellife representative indicated that this could be accomplished in their design without additional cost attached to the product.

The Chellife units were tested and accepted as equal to or better than the ILC units. The Chellife units were purchased for field testing. Initial testing and evaluation has determined the item to be a reliable and quality product.



Figure 3.4.7. I.L.C. Inflator, Front View





Figure 3.4.8. I.L.C. Inflator, 3/4 View

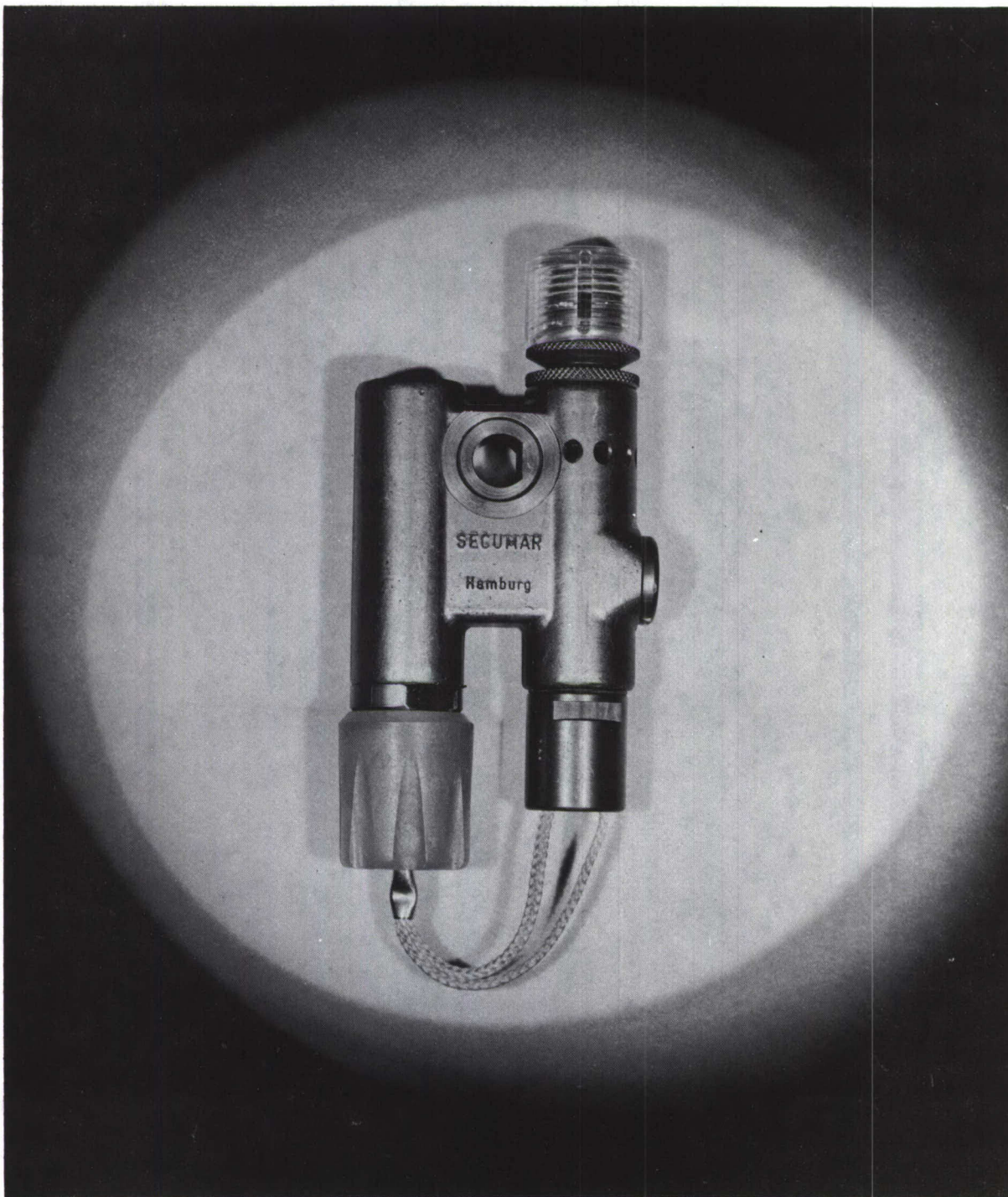


Figure 3.4.9. R.F.I. Inflator, Front View





Figure 3.4.10. R.F.I. Inflator, 3/4 View



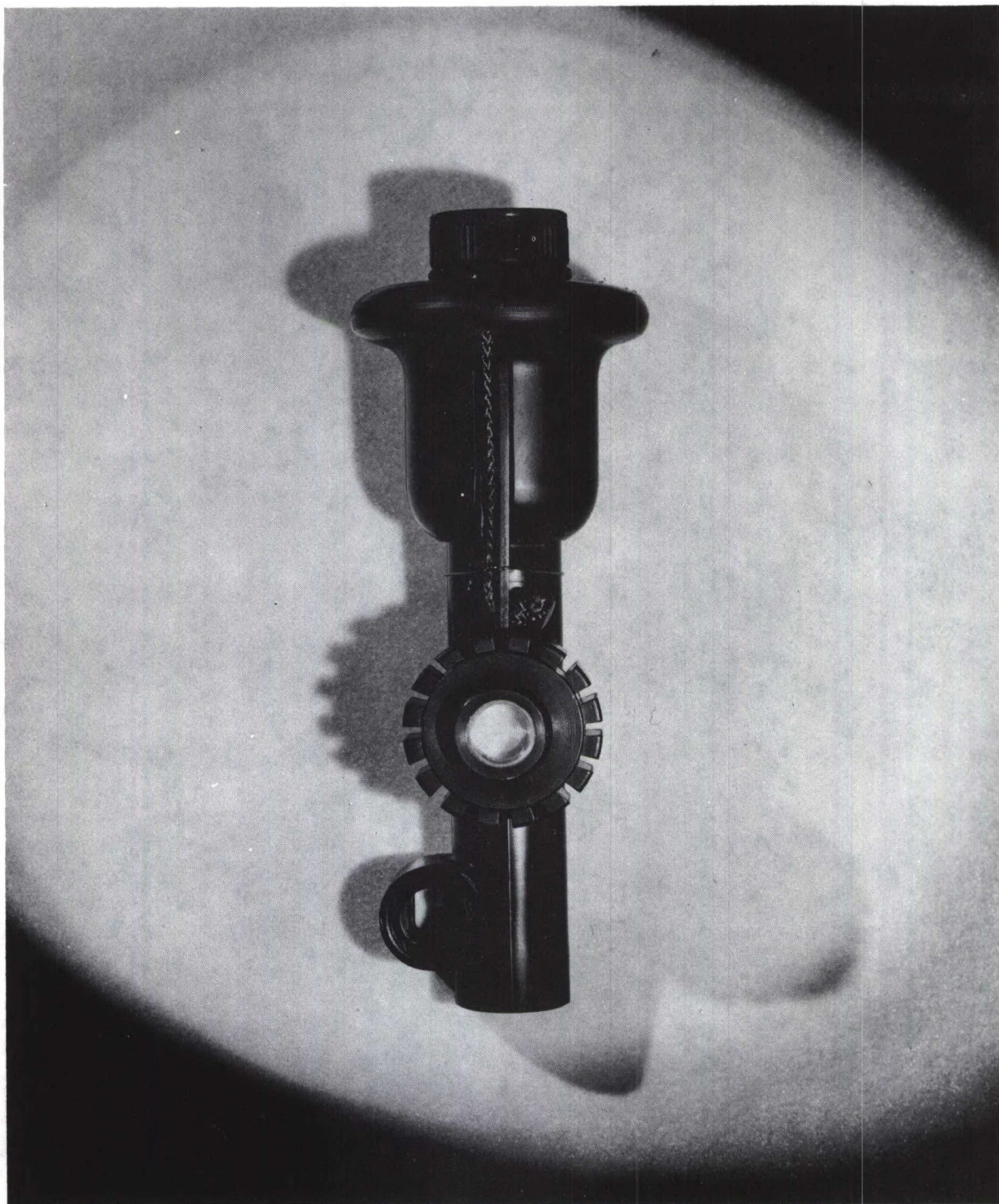


Figure 3.4.11. Chellife Inflator, Front View



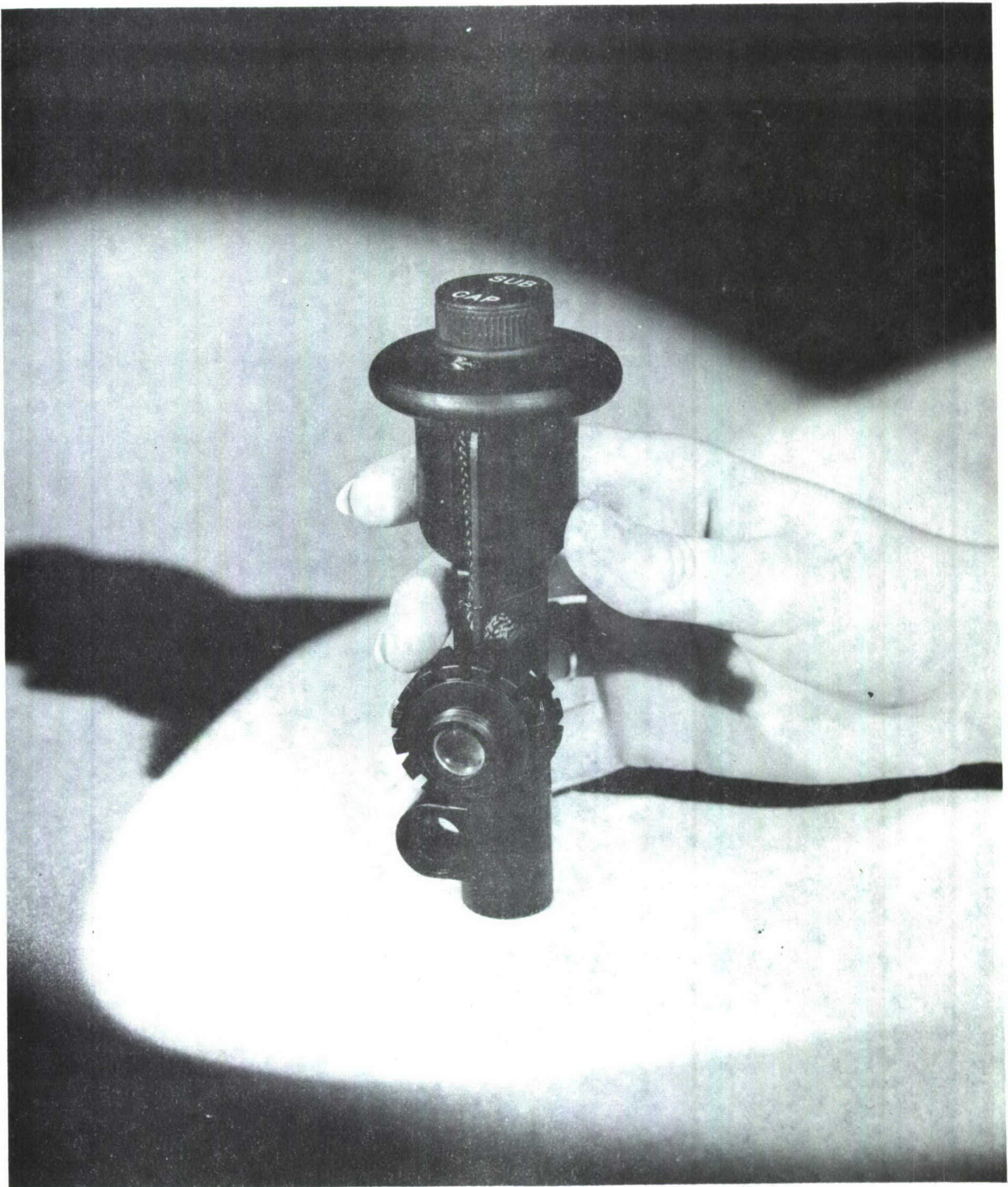


Figure 3.4.12. Chellife Inflator, 3/4 View

### 3.5 Pouch and Belt Configuration

The overall objective of this program was to develop a flotation gear system which would provide the "U" shaped flotation bag system as presented in USALWL Report No. 68-07 and also incorporate the following features:

- ° Be convenient to wear in the uninflated condition
- ° Not interfere with the field gear harness
- ° Inflate automatically upon immersion into 2 ft. of water
- ° Allow rapid discarding of equipment when required by tactical situation
- ° Be readily adaptable to waist sizes of 28 to 43
- ° Allow simple and quick repacking of gear after use
- ° Not interfere with equipment carried on cartridge belt
- ° Not interfere with the individual's movement when moving through tactical areas or attempting to maintain a minimum profile
- ° Weigh less than 2 lbs.

In essence, these requirements were relatively all encompassing. They required creative and diligent effort in the development of the pouch and belt configuration. A manikin, dressed with a complete issue of field gear, was used in the configuration development. Physiological charts relating to size and size variation were also used.

A 1 1/4" belt positioned above the cartridge belt was selected as the best means for affixing the "U" shaped flotation arrangement to the individual. The three flotation bags which form the "U" shaped configuration were packaged in their individual pouches. One pouch was positioned under each arm and one pouch was positioned on the vertical front center line of the body.

The inflator and gas source was positioned between the center and right side pouch in such a position that it would not interfere with the



movement of the right arm. The inflator is vertically positioned and manual inflation can be accomplished by either the right or the left hand.

Three pouch and belt configurations were designed and prototypes of each design were tested. The first design consisted of:

- ° A right bag and cover
- ° A left bag and cover
- ° A center bag and cover
- ° A freon gas inflator
- ° A belt which buckled in the back
- ° A manifold and gas tubing system

The first units were fabricated generally in accordance with the design shown in Figure 3.5.1. The deviation from the configuration shown in Figure 3.5.1 consisted of minor items. The inflation of the manifold belt was considered unnecessary and the manifold belt was replaced by tygon tubing. A cover was provided for each of the bags. Eyelets were provided at the top of the inflation bags and a tie cord incorporated to tie the bags together. Figures 3.5.2, 3.5.3 and 3.5.4 are photographs of these units.

Evaluation of three units fabricated as above indicated that the following improvements would be desirable:

- ° The buckle should be moved to the front, if possible
- ° The pouch dimension in the direction of the belt should be reduced in order to reduce interference with other gear on small waist sizes
- ° The pouch shall not present any openings away from the body in order to avoid catching on bushes, etc.
- ° The vertical dimension of the pouch could be increased but should be held to a minimum.
- ° Some provision must be made to allow greater adjustment of the side pouches for smaller waists
- ° The tie cords were not needed
- ° A more reliable disconnect should be provided

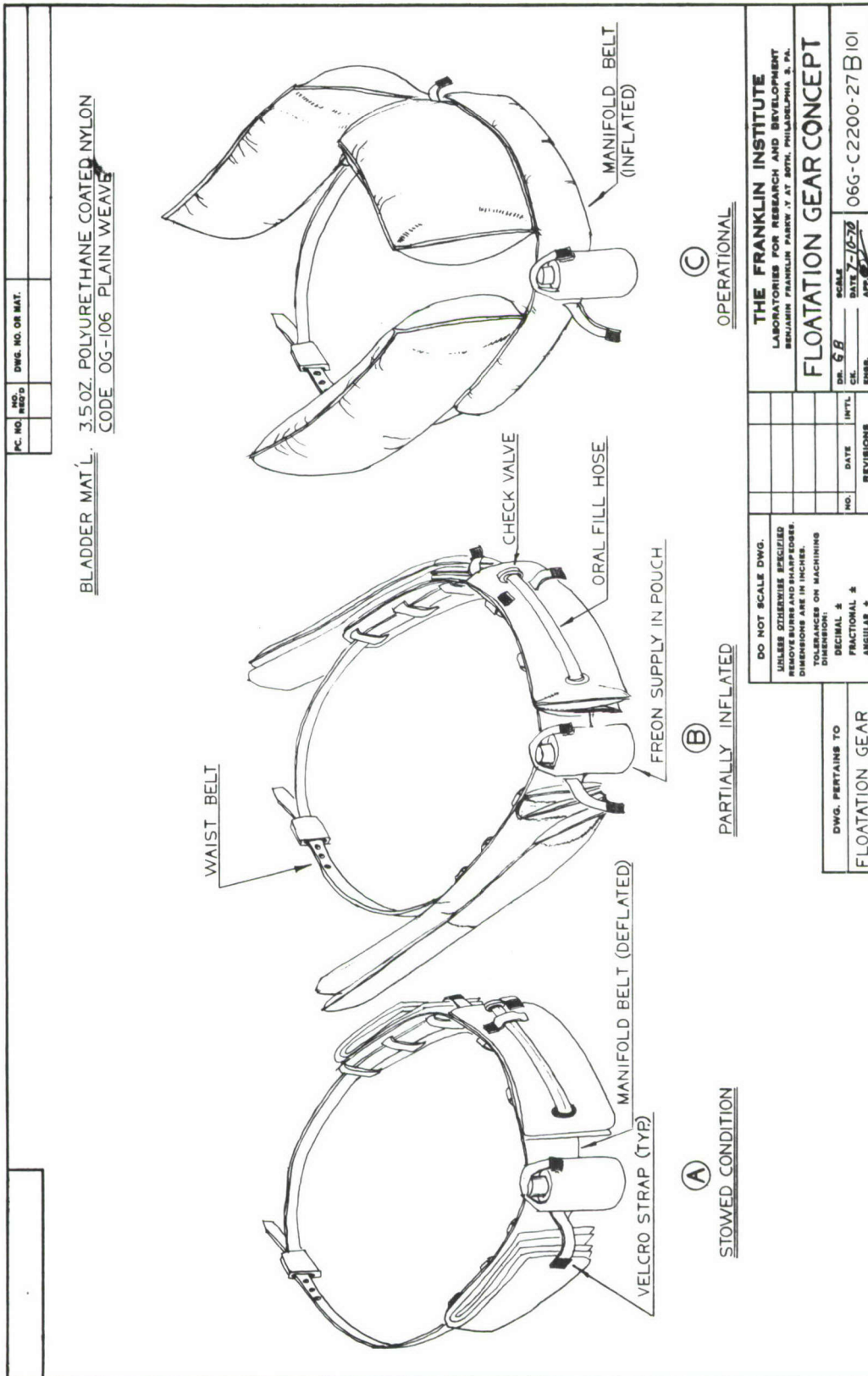


Figure 3.5.1.1. Floatation Gear Concept

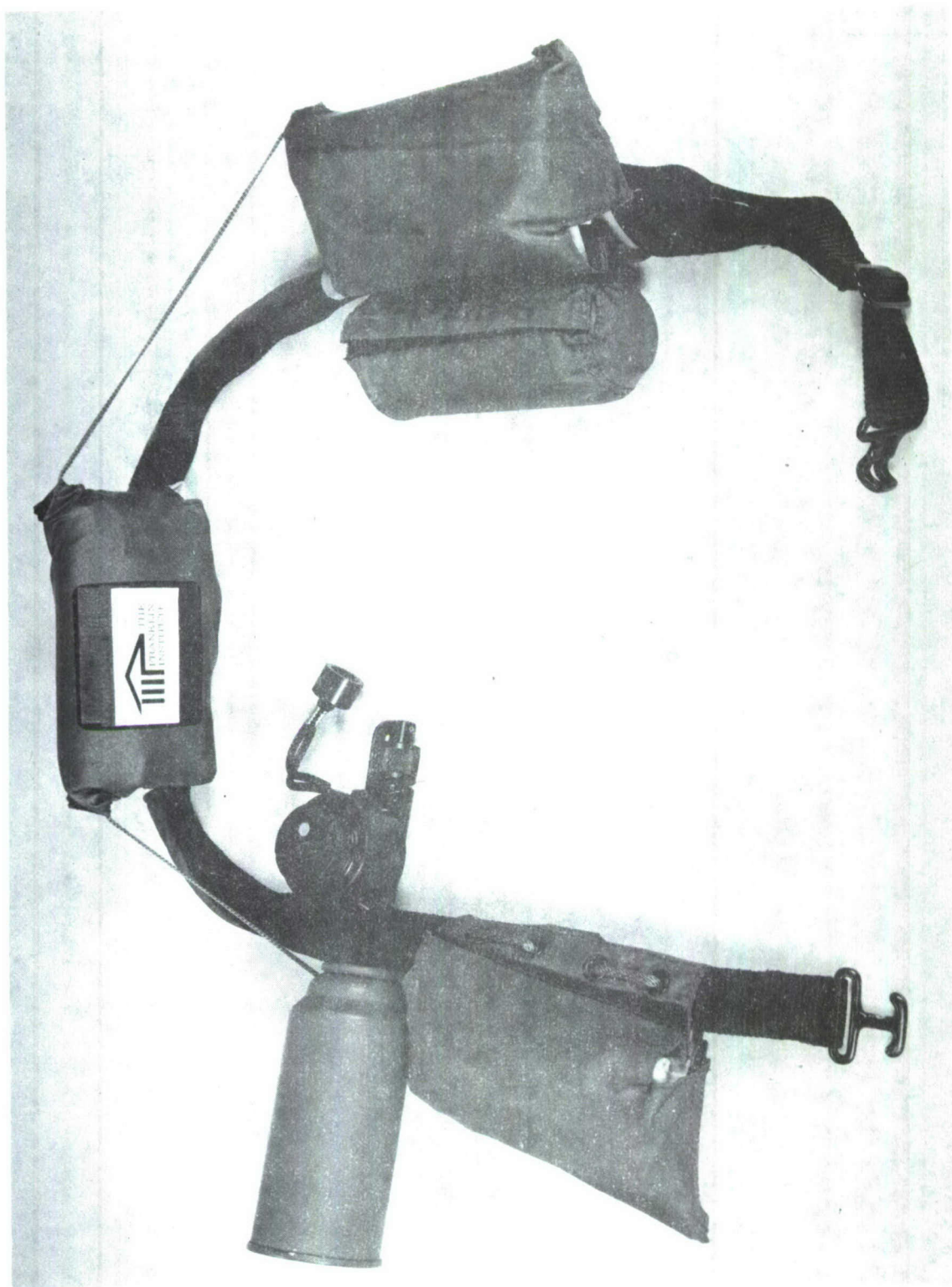


Figure 3.5.2. Flotation Gear





Figure 3.5.3. Soldier Wearing Flotation Gear





Figure 3.5.4. Soldier Wearing Inflated Gear

- ° Replace the oral fill hose with a larger inflation port to allow rapid deflation of the bags
- ° The pouches should be lowered on the belt in order to avoid rolling of the pouch when crawling.

A second design was developed. It was generally in accordance with the design shown in Figure 3.5.5. This design consisted of:

- ° A right bag and storage pouch
- ° A left bag and storage pouch
- ° A center bag and storage pouch
- ° A CO<sub>2</sub> gas inflator
- ° A 1 1/4" flat belt which buckled in the front
- ° A manifold and gas tubing system
- ° An expandable tube in the back to allow adjustment of left bag.

Four units were fabricated and tested. During testing and evaluation, the following factors emerged:

- ° Two sizes should be fabricated; the smaller size being suitable for issue to the very small waisted personnel of possible allied countries
- ° The two sizes should be identical except for a shorter belt and shorter expandable rear tube
- ° The bags should be of double thickness in the area of the belt in order to increase the strength in this higher stressed area.
- ° Operating instructions should be sewn in the front center pouch
- ° The distance between the centerline of the front pouch and the side pouch should be reduced to nine (9) inches in order to accommodate smaller waists
- ° Side bags should be increased two inches and affixed to the belt at their geometric center in order to provide increased buoyancy stability of the side bags and allow greater arm mobility.



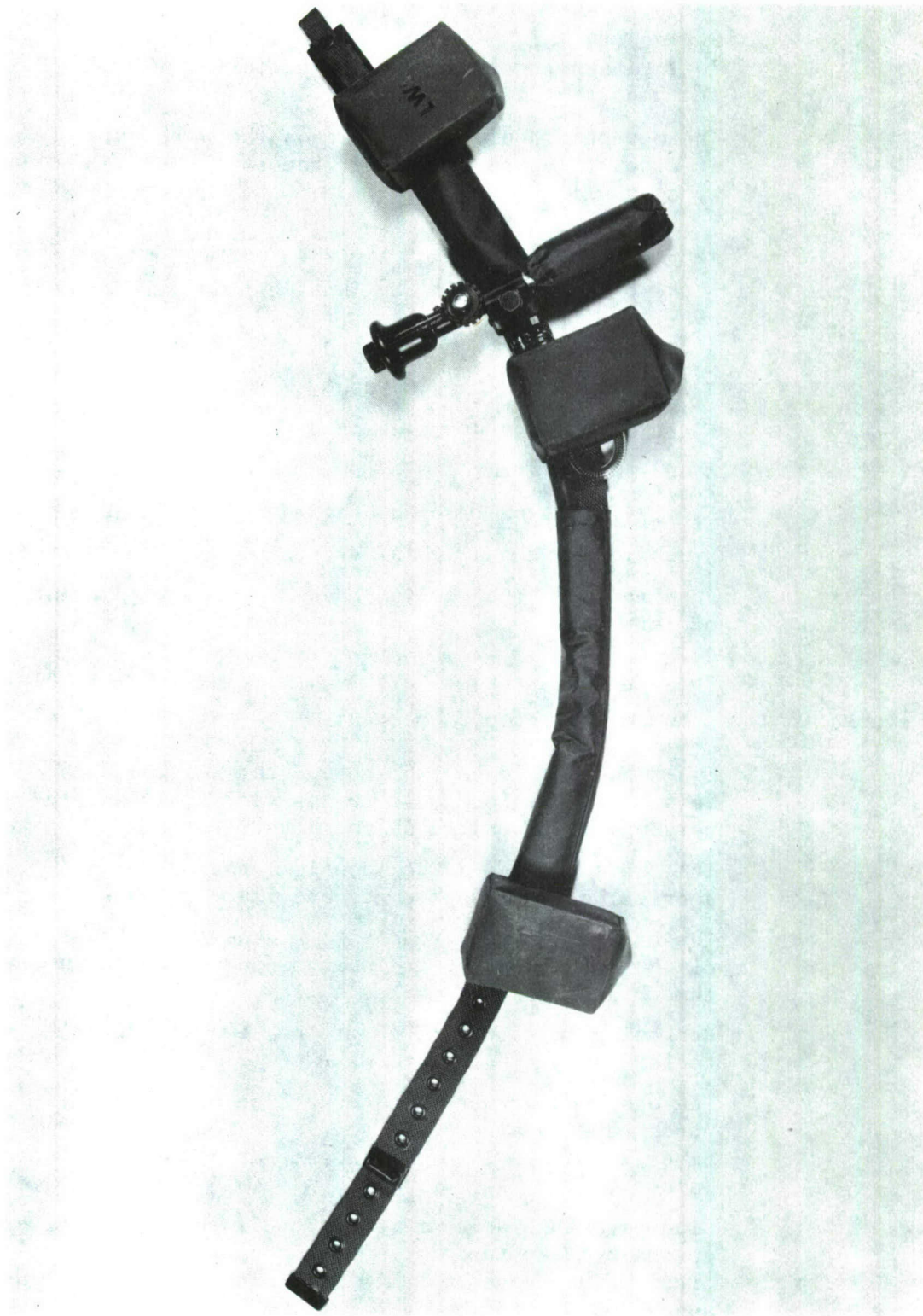


Figure 3.5.5. Flotation Gear



As a whole, the bag and belt configuration was satisfactory except for minor changes to adapt the units to smaller waist sizes.

Fifteen small units and thirty-five large units were fabricated. The units were 100% tested at the Bainbridge Naval Station swimming pool. Some difficulty was experienced due to failure of hose clamps. This was corrected by placing a .010 teflon shim under the clamp. No further difficulty was experienced.

The pouch, bag and belt configuration has been reviewed by numerous agencies and personnel and, in general, has been favorably received.

### 3.6 Belt Buckle

Rapid release of the flotation gear, when required by a tactical situation, was one of the features desired in the product.

The first design arrangement incorporated a buckle in the rear of the belt. The buckle was a standard military buckle often used on military gear where a quick disconnect feature is required.

During evaluation of these units it was concluded that this arrangement was unsatisfactory. The buckle or clasp should be in front, easily accessible, and operational with one hand.

A standard military trouser buckle was incorporated in the second design arrangement. The buckle was positioned in the front of the belt, just left of the front center bag. This buckle can be adjusted by pulling the rear belt tab to release the buckle teeth and sliding the buckle along the belt for proper adjustment. It can be released by pulling the rear tab and letting the rear tab slide out of the buckle.

This was considered unsatisfactory by the military review team. It is a one-hand operation but is not as convenient as desired.

Considerable additional effort was required to find a simple reliable quick-disconnect buckle or clasp. Numerous original concepts were sketched and reviewed.

In one design variation of the fatigue belt buckle the standard pivot pin was replaced by a release pin which then served as both the pivot and a quick release. The end of the pin was formed into a loop, to which a lanyard could be attached. Another variation provided a means for release of the normal locking attachment jaw. Upon further consideration of the specific details of these designs, it was decided to reject them because they still provided less than ideal operating characteristics and the manufacturing modifications would have substantially increased the cost.

Still another part of the problem of using the standard buckles was what to do with the excess length of belt tab. When the belt is cinched up leaving a tab more than a few inches long, it becomes awkward and obtrusive.

Next, the automotive type seat belt buckles were considered. Approximately ten manufacturers were contacted. Two provided some information on their existing line of buckles; however, these were standard commercial items and were generally not well suited to a military application for the following reasons:

- a. They are designed for use with thinner, 2-inch wide belt material
- b. They are relatively heavy and complex
- c. The design puts more emphasis on stylish appearance than on environmental durability.

At best, any of the existing buckles could serve only as a concept for a new design.

An automotive type quick release buckle that is manufactured for the Navy and Air Force for use with aircraft ejection seats was also evaluated. These devices are referred to as mini lap belt fittings and are manufactured by H. Kock and Sons, a subsidiary of Gulf and Western Corp. They are well suited for their intended purpose but are very expensive and the construction, which is designed to withstand the high G forces imposed during flight, is much more substantial than is needed

for the flotation gear application. As a result of all of the inquiries that were made, it became apparent that a new buckle should be designed specifically for this application. The prime design factors were:

- (a) Simplicity
- (b) Lightweight
- (c) Low cost

The desired characteristics were:

- (a) Quick positive release
- (b) Reliability with minimum chance for accidental release
- (c) Adjustability to suit various waist sizes
- (d) Provision for stowing the excess belt tip.

The first approach tried for a combination of the standard fatigue belt buckle and a flexible steel belt lacing, as shown in Figure 3.6.1. A velcro tab was provided on the pin to prevent it from falling out or being accidentally released and also it served as the tab for intentionally pulling the pin.

The coarse belt adjustment was integral with the left side bag adjustment so that a free belt tip would always be less than 3 inches. Disadvantages in this design include the fact that the left side bag and belt waist adjustment were not independent; the possibility of the disconnect pin binding; numerous pieces and anticipated difficulty in reconnecting the belt in the dark because of the small diameter pin.

Another design was based on the parachute rip cord pin and cone concept as shown in the sketch, Figure 3.6.2. The method for making part of the quick release buckle also function as the waist size adjustment was developed at this time. The first model of this design had two cones and a pin but it was shown that a single cone and pin could be used and would reduce the size and weight, eliminate the problem of alignment of the pin holes, and make the size adjusting easier. One other significant aspect of this concept was that the problem of what to do with the excess length of belt tab was solved; it was now possible to run it behind the belt.



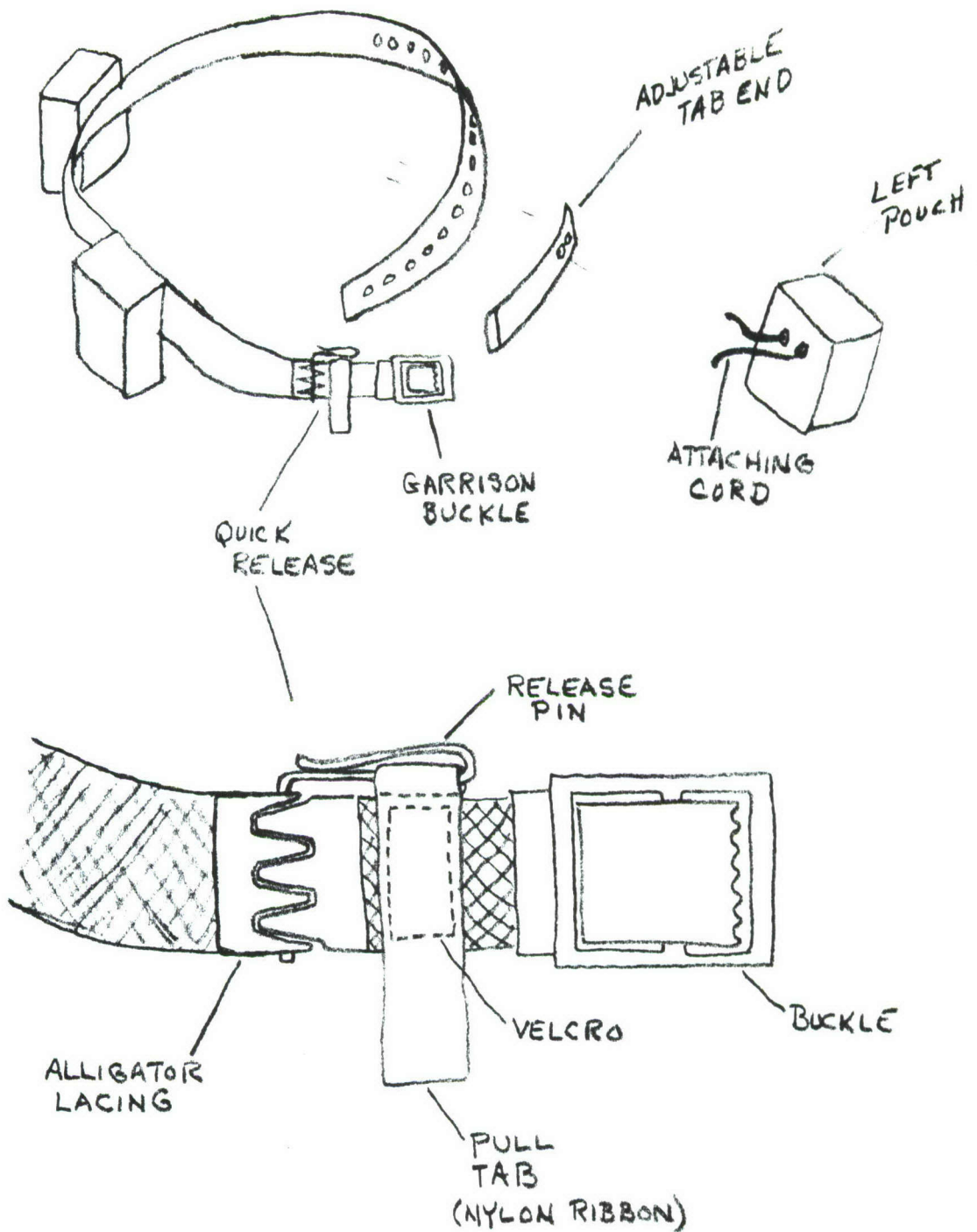


Figure 3.6.1. Buckle Concept

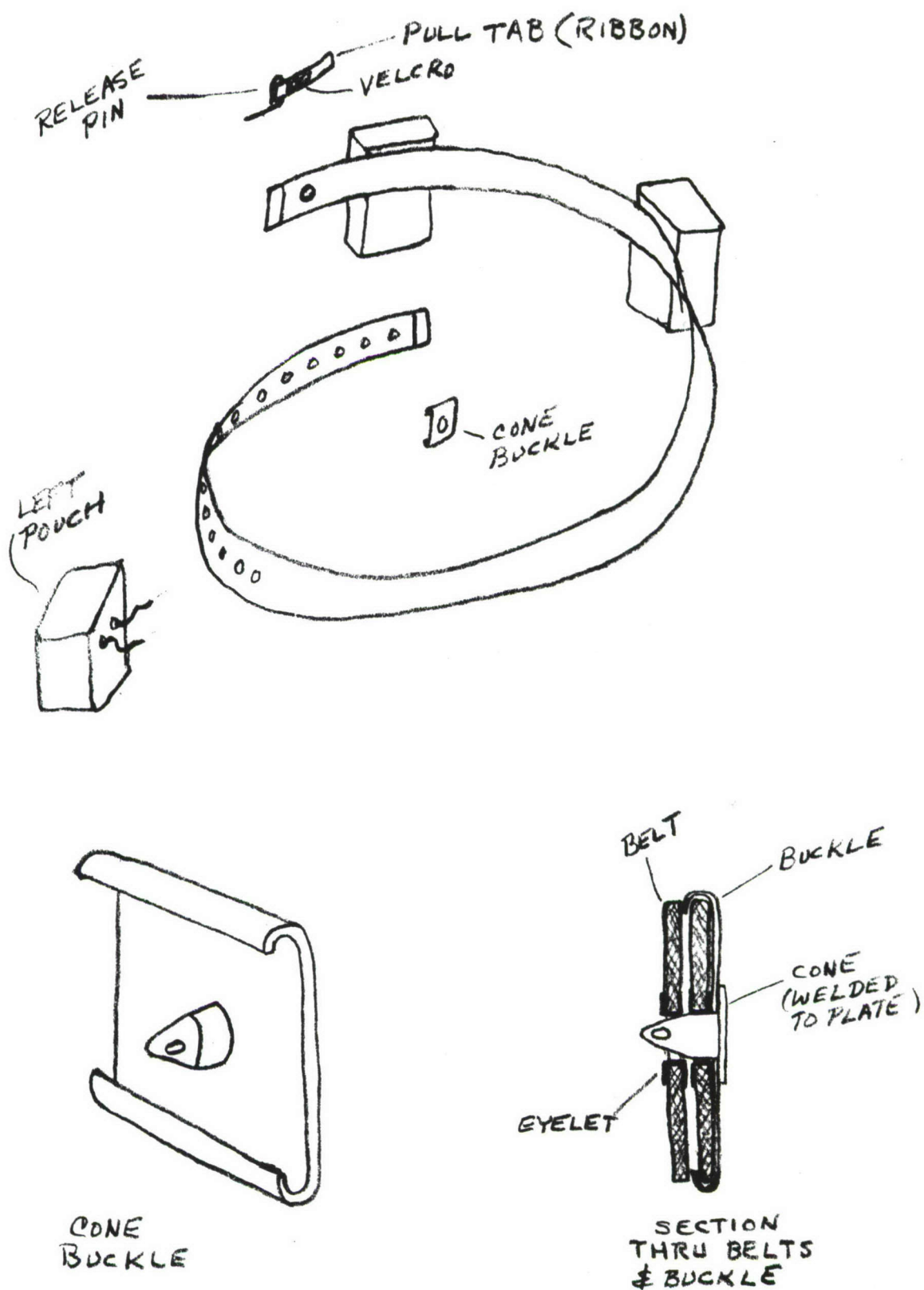


Figure 3.6.2. Buckle Concept

The concept was good in terms of the operating characteristics but the cone and pin configuration was still somewhat less than ideal. Personnel at LWL suggested a combination of the FIRL waist size adjustment with the new rucksack release. The final design, which embodies all of the originally desired features, is shown in Figure 3.6.3.

This configuration was incorporated in the fifty units delivered for field evaluation and testing.

The buckle was tested and proved to be very successful. The buckle is reliable and yet is extremely easy to release by a simple tug of the release tab. The buckle was evaluated by a military review team and received very favorable comments.

### 3.7 Manifold and Check Valves

Provision had to be incorporated into the design to insure that each flotation bag would inflate to its required level. Originally this was established at .43 cu. ft. of gas in each side flotation bag and .25 cu. ft. of gas in the front flotation bag. This was the criteria established by USALWL technical report no. 68-07.

All three bags are inflated from the same gas source, and therefore it is necessary to provide some means for dividing the flow of the gas to the three bags. This is accomplished by flow control orifices in the manifold.

In the first design package a hollow pin in the inflator was used to conduct the freon 12 from its container and restrict expansion at the container mouth. Restrictions within the tubes and the low pressure freon provided reasonable gas distribution.

The second design package operated on CO<sub>2</sub>. Since the CO<sub>2</sub> is stored at a high pressure (838 psig), flow control is more critical. The orifices must restrict high pressure surges as well as divide the flow.

The flow of the gas to any bag is dependent on the restriction created by the control orifice, the line restriction, the restriction



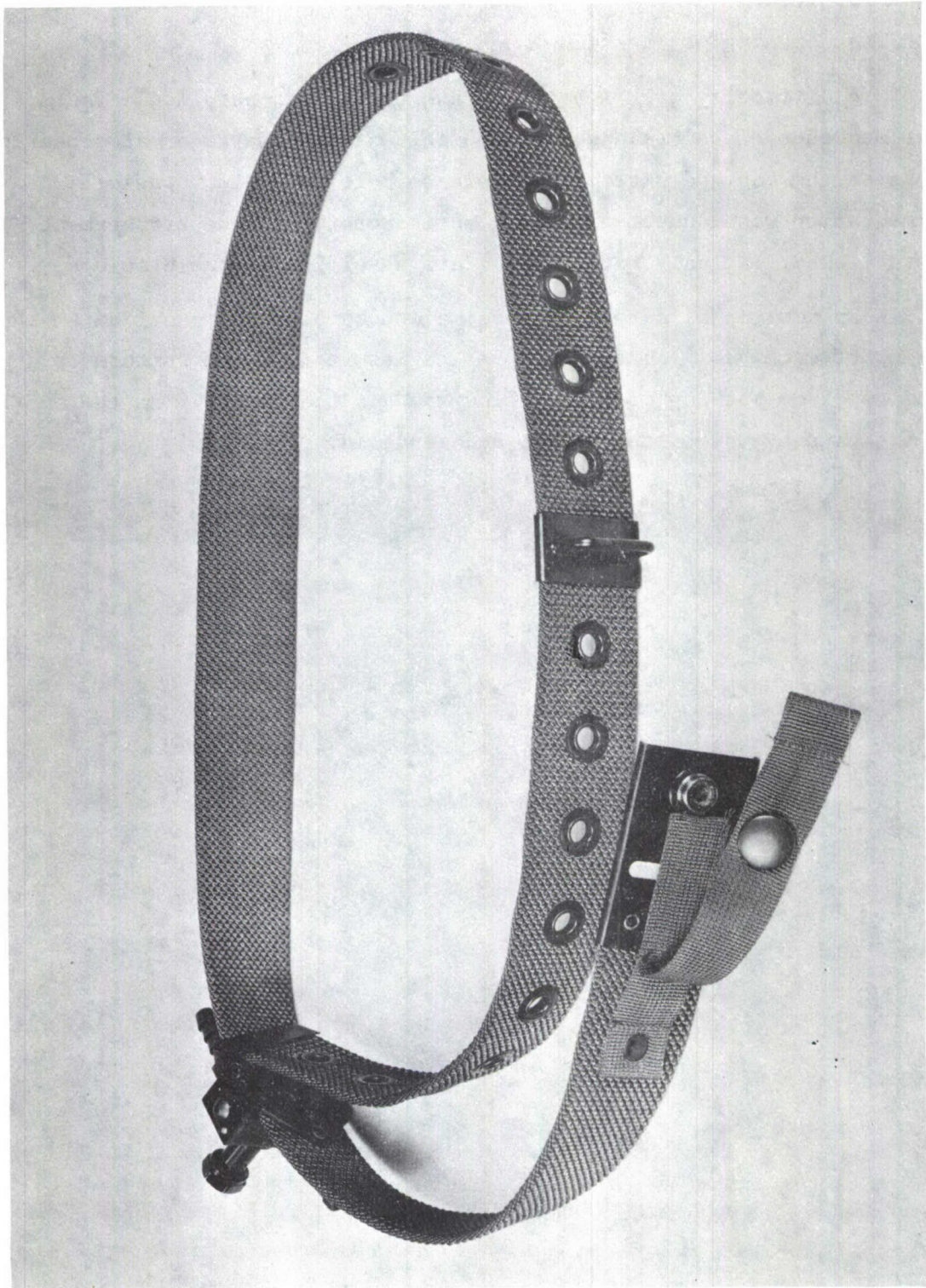


Figure 3.6.3. Adjustable Quick Release Buckle

of the hole pierced in the CO<sub>2</sub> cylinder and any other element restricting the bag from opening or expanding.

Some difficulty was experienced due to the uncontrollable factors, such as sequence of bag release from pouch, external water or atmospheric pressure on the bag and size of gas release hole in the CO<sub>2</sub> canister. Experimentation was conducted until a satisfactory orifice arrangement was established. Actual orifice sizes are specified in the drawings.

As an additional safety measure, a check valve was provided at the gas inlet of each bag. These check valves insure that the rupture or loss of gas from one bag will not allow the gas to release from the other two bags by way of the tubing and manifold.

## 4. DESCRIPTION OF PRODUCTION PROTOTYPES

### 4.1 General

The flotation gear is shown in the photograph, Figure 3.5.5. It consists basically of an assembly of three bladders or bags which are the flotation cells, a precharged carbon dioxide cylinder and a dual mode inflation valve. Manual inflation is always possible; automatic inflation can also be selected by the individual. In the automatic mode, the device will inflate when it is submerged to a depth of two feet.

The bags are folded and stored in individual pouches and affixed to a belt which is worn around the waist. The pouches are designed to be opened by the bag itself when it inflates. One bag is located on each side and one directly in front of the user. The left side bag is adjustable on the belt and can be positioned to suit the waist size of the individual. An instruction flap is sewn into the inside of the front bag and the pouch is marked top center to insure proper orientation.

A two ounce CO<sub>2</sub> cylinder is screwed into the inflator valve which is mounted on the belt to the right of the front bag. The CO<sub>2</sub> gas is carried to each bag from the manifold through flexible plastic tubing. The tubing is confined along the belt and protected by cuffs. One gas cylinder is used each time the gear is inflated. A small nylon fabric bag with an elastic top is provided to cover the cylinder.

All of the metal parts are specified to have a dull black or O.D. finish. Because of the relatively small quantity of materials used to produce the fifty prototypes, some concessions were made; for example, the tygon tubing is clear - in larger quantities black tubing should be specified. Also the flanged elbows on the flotation cells can be molded in an O.D. color in production lots.





The various component parts have been located on the belt in such a way as to provide the least possible interference with the commonly used military gear such as the field pack, ammunition pouch, first-aid pouch, canteen, etc. A large dump valve is provided in each bag to facilitate rapid deflation. The flotation gear has been designed to support a combat soldier with a full field pack weighing approximately 60 pounds.

The belt is made with a combined quick adjust, quick release buckle assembly, that can be adjusted to fit the individual waist size. The belt itself is made to cover two general size ranges.

The small to medium range covers waist sizes from 23 to 43 inches, and the medium to large range covers waist sizes from 28 to 42 inches.

The flotation gear is designed to be worn just above the normal belt line, with the inflation valve on the right side of center, between the front and right side pouches, as shown in the photographs, Figures 4.1.2 and 4.1.3.

In conjunction with other field equipment, the flotation gear should be worn under the web gear and rucksack frame and over the parachute harness. The left side pouch should be adjusted so that it is directly beneath the left arm.

Figure 4.1.4 shows the flotation gear as worn with the parachute harness.

## 4.2 Inflation Valve

Chellife valves, as shown in Figures 3.4.11 and 3.4.12 were provided with the fifty prototype flotation gear. These inflators are designed to mount on the standard military "D" stud and are interchangeable with any of the manifolds. Tolerance between "D" stud and inflator body permits rotation on the "D" stud of approximately 6 degrees.

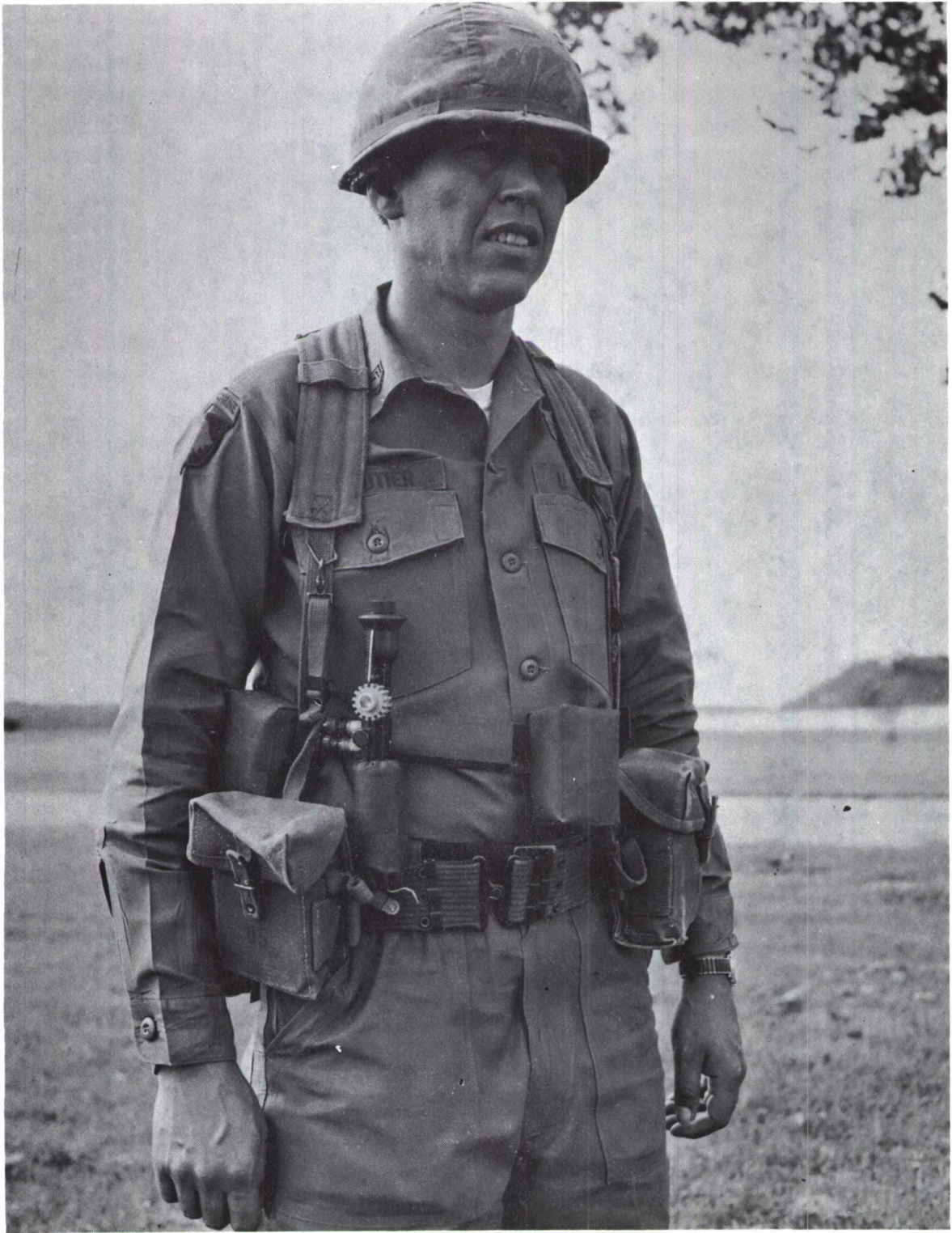


Figure 4.1.2. Soldier Wearing Flotation Gear





Figure 4.1.3. Soldier Wearing Inflated Gear





Figure 4.1.4. Flotation Gear Worn with Parachute Harness

Manual inflation with the Chellife valves can be accomplished at any time by pulling straight up on the manual inflation knob on the upper end of the valve.

Operating and recharging procedures are outlined in Section 5 of this report.

These inflators weigh about 4.5 ounces.

It should be reasonable to specify that inflators will not "fire" at a depth of less than six inches, but before a depth of 30 inches when the sinking rate is low, (about 1 inch per second in a stillwell); however, it would be prudent to conduct some additional testing to obtain more statistical data on depth vs. time. Evaluation of this data would serve as a basis for the establishment of a practical requirement to be included in the specifications for ordering production valves.

#### 4.3 Belt

The belt material is a green nylon woven fabric, 1/8" thick and 1 1/4" wide. Even though the specification for the belt material was so unrestricted, a considerable number of inquiries had to be made in order to place an order. Only one manufacturer, Bally Ribbon Mills, would quote on any quantity less than about 50,000 ft. This same manufacturer also set up and produced the 100 feet of nylon strap material required for the quick release assembly.

Final design of the quick release buckle established the belt lengths as shown on the belt assembly drawing No. D-312301. The medium to large belt, which will accommodate waist sizes 28" to 42", is 43" long and the small to medium belt which will accommodate waist sizes from 23" to 34" is 35" long. Eighteen eyelets are provided in the large belt and fifteen in the small belt, to locate the buckle "D" ring.

The quick release tab is fabricated from 3/4" Nylon Ribbon. A small strip of solid nylon sheet is sewn into the ribbon to provide rigidity where it locks the buckle and "D" ring together. A simple



snap fastener is used to retain the tab end.

Cut ends and punched holes in the belt should be heat seared to prevent unravelling of the threads.

#### 4.4 Buckle

The complete buckle assembly consists of the buckle plate, "D" ring and ribbon tab.

The "D" ring is mounted on a plate which fits across the 1 1/4" width belt and has a stud on the back to engage the eyelet which will provide the best fit to the individual's waist. The "D" ring plate is installed on the belt with the ring facing outward from the body by bending the belt across its width into a slightly concave shape and slipping the edges into the channeled ends of the plate. The belt is then flattened so that the stud engages one of the eyelets. The belt is worn with the excess belt tab behind the buckle end. The buckle is connected to the "D" ring by inserting the ring through the slot in the buckle. The ribbon tab is inserted through the "D" ring and the tab end button is snapped in place to lock the assembly together.

The belt is removed by grasping the ribbon tab with the right hand and pulling to the right.

A picture of the closed belt assembly is shown in Figure 4.4.1.

#### 4.5 Air Cells

The Air Cells or bags are fabricated from olive drab polurethane coated nylon fabric which weighs 5 to 5 1/2 ounces per square yard. The side bags are 26 inches long, and the front bag is 20 inches long. In the earlier development stages the bags were of equal length; however, the side bag length has been increased in order to shift the center of buoyancy so that the individual would float in the proper position and also to soften the side bags, making it easier for the individual to move his arms and maneuver in the water. A dump valve and a flanged





Figure 4.4.1. Belt and Buckle

inlet elbow is heat sealed into each bag. The bag itself is folded and sealed on three sides to form the air cell. In a subsequent operation, the air cells are heat sealed to the pouches and to a reinforcing strip in the area that forms the belt loop. In addition, eyelets are installed on the left bag and a small length of nylon cord is tacked to it to provide the adjustable feature.

#### 4.6 Pouch

The pouches are fabricated from the same nylon material as is used for the air cells; however, the material is doubled and sealed to form a continuous two ply sheet. The corners are internally seamed and the edges are heat creased to provide stiffness and a box-like shape. Velcro tape hook and pile strips are sewn to the rear flaps to be used to close the pouch and retain the air bag. Basically, all of the pouches are the same; the only difference is that the front bag has the letters LWL silk screened on the front and the words "center top" on the top. The front bag also has the instruction sheet sewn inside. The pouches are joined to the air cells, and reinforcements at the belt loop. The instructions are silk screened on white 3/4 ounce "Rip Stop" nylon cloth; one panel shows an exploded view and the nomenclature for the inflation valve, and the second panel describes the operation and procedure for recharging the inflator. These panels are folded into the pouch under the air cell.

#### 4.7 CO<sub>2</sub> Canister Cover

The canister cover was designed to serve two purposes:

- (a) To insulate the gas cylinder to prevent freeze burns when it is discharged, and
- (b) To eliminate the reflection from the bright metal finish.

The canister cover is fabricated from a single ply of nylon material, the same as is used for the air cells. It is hemmed on both ends and has the seam along its length. An elastic strip is sewn into



the top end to allow the material to be spread open to slide over the cylinder and contract around the neck of the cylinder to hold the cover in place. The bottom end is closed.

#### 4.8 Manifold

The purpose of the manifold is to provide a mounting for the inflation valve and also to distribute the carbon dioxide gas to the flotation cells by way of the flexible tubing.

A manifold is machined from aluminum bar stock. It is designed to fit into the manifold bracket which is permanently riveted to the flotation gear belt. The manifold is attached to the bracket with two 8-32 binding head screws with nylon inserts. The previous design had milled channels on the top and bottom surfaces which fit closely to the manifold bracket to prevent the manifold from rotating. The present design is less expensive to machine, the milled channels have been eliminated and the close tolerances between the manifold and bracket are no longer necessary. A pin, pressed into the manifold, fits into a hole in the bracket to provide positive positioning and prevent rotation. Disassembly of the manifold from the bracket is accomplished by removing the binding head screws and the spacer washer at the bottom of the manifold. This allows the manifold to drop down so that the positioning pin clears the hole in the bracket, and the manifold can then be lifted free of the bracket.

The manifold outlet ports are tapped 1/8 inch NPT to accept the tube adapter fittings. The body is internally drilled to distribute the carbon dioxide gas from the "D" stud inlet to the three outlet ports.

The "D" stud dimensions and tolerances are based on the standard military configuration<sup>\*</sup> common to inflatable life vests, rafts, etc. The inflation valve is mounted on the "D" stud with a sealing washer on

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<sup>\*</sup>Bureau of Naval Weapons, Drawing No. 62A120H1 (Mil-L-6077G).



each side of the valve port and retained with a cap nut. The washer between the manifold and the valve body is a high durometer neoprene, and the washer under the cap nut is nylon. These washers are supplied by the inflator manufacturer. In addition to their sealing function, they also serve as spacers to prevent bottoming of the cap nut.

#### 4.9 Piping

The principle design considerations for the piping included flexibility, lightweight and corrosion resistance. Tygon brand polyvinyl chloride tubing was selected for the tubing between the manifold and the front and right side flotation cells. A larger diameter P.V.C. tubing is reformed to include an expandable convoluted bellows section for the tubing run between the manifold and the left side flotation cell. The length of this run of tubing is required to be variable to accommodate the repositioning of the left side cell to fit different waist sizes.

A check valve is pressed into the flanged elbow on each flotation cell. The check valves seal the carbon dioxide gas in each cell so that if one of the cells should be subsequently punctured, there will be no loss of pressure in either of the others.

A stainless steel coil spring is inserted into the tubing for the right side cell to prevent the tubing from collapsing when it is bent sharply. A small flat washer must be installed between the spring and the check valve to prevent the end of the spring from entering and jamming the check valve. A flat coil of nylon is used in a similar manner in the larger diameter tubing between the manifold and the left side flotation cell. Each tube is connected to the manifold through a polyethylene tube to pipe adapter fitting.

Balancing orifices are also pressed into the adapters.

## 5. OPERATING PROCEDURE

### 5.1 Manual Mode

The subverter cap is screwed onto the sensing unit, covering the indicator window, when only manual operation is desired. In this condition inflation can only be initiated by pulling up on the manual pull knob.

### 5.2 Automatic Mode

The subverter cap is screwed and stored on the top of the manual pull knob, when the automatic inflation feature is desired. In this condition, the valve will automatically inflate the flotation gear when it is submerged to a depth of two feet. Note that the manual operation is in no way compromised and can be implemented at any time.

### 5.3 Recharging the Inflator

After manual inflation, the system is recharged by reinstalling the manual pull knob on the valve body and replacing the CO<sub>2</sub> cylinder.

Automatic inflation will be indicated by the appearance of a red spot in the sensing unit indicator window. Recharging after automatic inflation must be in accordance with the following procedure.

### 5.4 To Disassemble

- (a) Remove the manual pull knob from the spring retaining nut
- (b) Unscrew the spring retaining nut from the valve body
- (c) Remove the firing spring
- (d) Unscrew the sensing unit head
- (e) Remove all the pieces of the ruptured paper disc from the Auto Retaining Pin and inside of the Sensing Unit Head
- (f) Remove the auto retaining pin from the valve body
- (g) Remove the auto firing mechanism from the valve body
- (h) Slide the manual firing cylinder over the end of the firing pin; then while exerting some side pressure, extract the firing pin from the valve body.



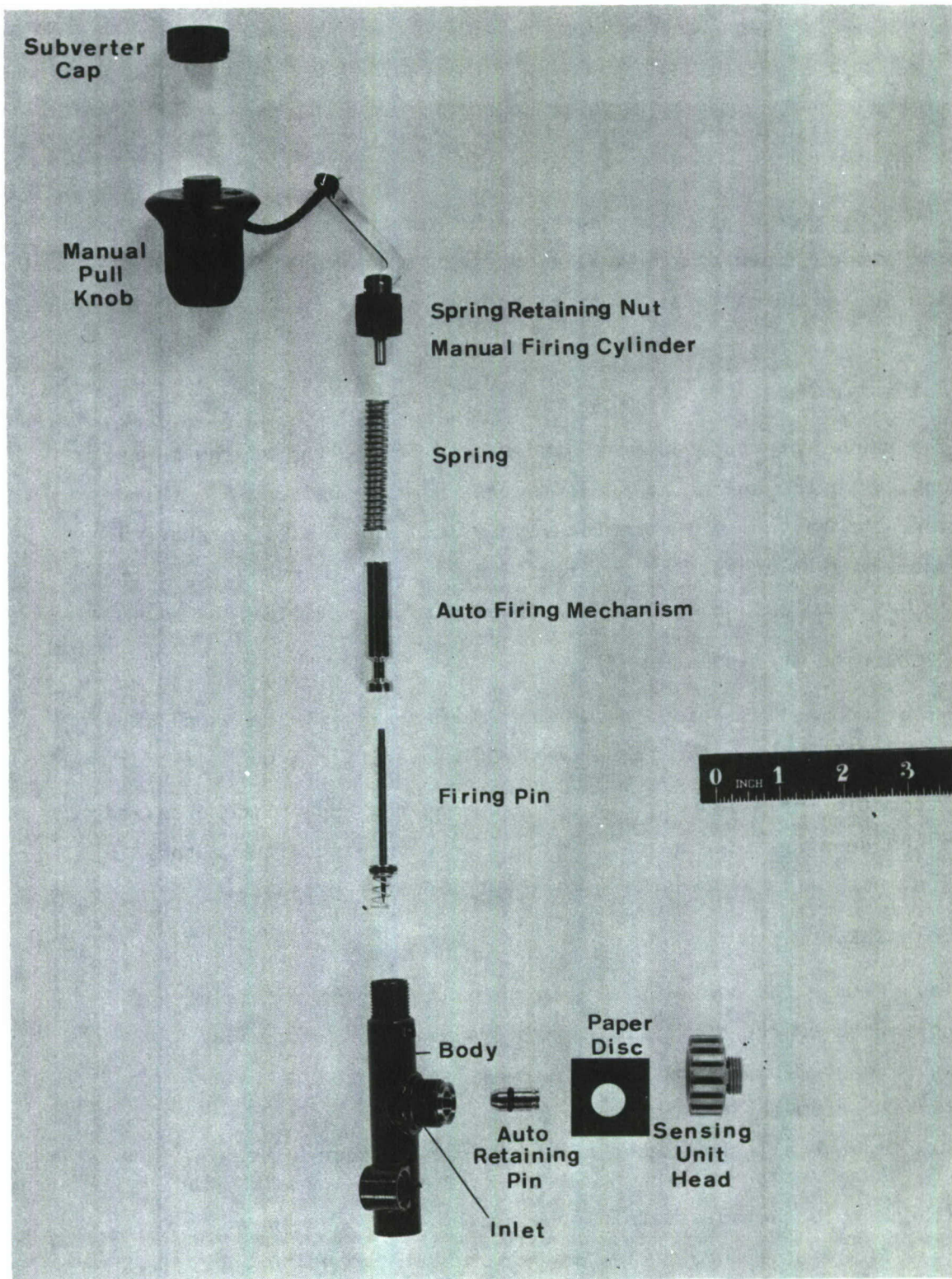


Figure 5.1.1. Inflator, Exploded View



- (i) Examine the tip of the firing pin to be sure it is still sharp.

## 5.5 To Reassemble

- (a) Precautions: Parts should be dried before reassembly and special care should be taken to prevent damaging or interchanging any of the "O" Rings
- (b) Insert the firing pin leaving about one inch extending out of the valve body
- (c) Slide the automatic firing mechanism over the pin and into the valve body
- (d) Locate the groove in the auto firing mechanism at the bottom of the auto retaining pin water inlet
- (e) Push the auto retaining pin into the water inlet; the end of the pin will be flush with the top of the barrel if the auto firing mechanism groove has been properly located.
- (f) Place a new paper disc over the end of the auto retaining pin
- (g) Screw the sensing unit head on, hand tight
- (h) Replace the spring
- (i) Replace the spring retaining nut by sliding the manual firing cylinder over the end of the firing pin and screwing down the nut
- (j) Fold down and align the manual pull lever with the nearest slot on the sensing unit head
- (k) Check the condition of the paper disc by observing it through the window
- (m) Install a new CO<sub>2</sub> cylinder - be sure to transfer the nylon cover to prevent freeze burns when the cylinder is discharged
- (n) Install the subverter cap to provide the desired mode of operation.

## 5.6 Repacking the Flotation Gear

- (a) Deflate each bag by pulling the tab to open the dump valve
- (b) Fold the bag longitudinally in a "Z" form with the inlet fitting side down
- (c) Starting at each end, fold in toward the center; fold over each end three times
- (d) Press on the bag to expel the air, then close the dump valve.

- (e) Fold each end over the valve area
- (f) Flip the pouch over from the opposite side of the belt and stuff the folded bag into it
- (g) Close over the pouch tabs and press the Velcro Tapes together.

## 6. DESIGN SPECIFICATIONS

### 6.1 Drawing List

Flotation Gear Assembly	060045000
Cuff	060045009
CO <sub>2</sub> Cylinder Cover	060045008
Piping Subassembly	060045002
Manifold	060045012
Orifice	060045014
Bag & Pouch Assembly	060045003
Flotation Bag, Left Side	060045004
Flotation Bag, Right Side	060045005
Flotation Bag, Front	060045006
Pouch Pattern	060045010
Instruction Tag	060045007
Belt Assembly	060045001
Manifold Bracket	060045013
Buckle Assembly & Details	060045011



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## DOCUMENT CONTROL DATA - R &amp; D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Franklin Institute Research Laboratories Benjamin Franklin Parkway Philadelphia, Pennsylvania 19103		2a. REPORT SECURITY CLASSIFICATION Unclass.	
3. REPORT TITLE  Lightweight Flotation Gear for Individual Soldiers with Semi-Automatic Inflation Device.		2b. GROUP	
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Technical Report No. LWL-C41-71, January, 1972 (Final)			
5. AUTHOR(S) (First name, middle initial, last name) Richard C. Quinn (FIRL) Donald F. DeCleene (FIRL) and William H. Collins (FIRL) Norman P. Leibel (LWL)			
6. REPORT DATE January, 1972		7a. TOTAL NO. OF PAGES 57	7b. NO. OF REFS 1
8a. CONTRACT OR GRANT NO. Contract No. DAAD05-71-C-0444		9a. ORIGINATOR'S REPORT NUMBER(S) 56G-C3123	
b. PROJECT NO. LWL C41-71		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)	
c.			
d.			
10. DISTRIBUTION STATEMENT  Approved for public release; distribution unlimited			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY U.S. Land Warfare Laboratory Aberdeen Proving Grounds, Maryland 21005	
13. ABSTRACT <p>The purpose of this task was the finalization of the design of a lightweight, reuseable, flotation device for the individual soldier.</p> <p>This task had two basic objectives. The first was to make a comparative evaluation of the automatic inflation valves which are available from three different manufacturers.</p> <p>The second objective was to fabricate fifty preproduction prototypes of the inflation gear. Fabrication of these prototypes facilitated finalizing the design of the component parts which were then detailed on fabrication and assembly drawings.</p> <p>The complete flotation gear weighs approximately two pounds. It consists of three separate flotation cells mounted on an adjustable belt. The device is inflated either manually or automatically by releasing carbon dioxide gas from a small pressurized cylinder. If required, the device can also be breath inflated.</p> <p>This report provides a comprehensive description of the inflation gear, along with some discussion of the alternate designs that had been considered and the decisions that led to the selection of the final components.</p>			